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PRINCIPAL CONTENTS.

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MINISTRY OF AGRICULTURE AND FISHERIES.

ORMSKIRK POTATO TRIALS.

ANNUAL REPORT FOR 1919 OF THE TRIALS OF VARIETIES OF POTATOES IMMUNE FROM WART DISEASE.

SUMMARY OF CONTENTS.

Copies of this publication may be obtained from the Office of the Ministry, 3, St. James's Square, London, S.W.1. Price 1s. 6d. net, post free.

CONTENTS.

THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXVII. No. 8.

NOVEMBER, 1920.

NOTES FOR THE MONTH.

Prices for British Wheat.

It would seem that some misapprehension still prevails regarding the present and future prices of wheat. In the circumstances it is desirable to recapitulate here the precise position as it was stated in the House of Commons by Sir Arthur Griffith-Boscawen, Parliamentary Secretary to the Ministry, on 15th June, 1920. It is not proposed to make any change in the maximum price for home-grown wheat of the present (1920) harvest. This price, as already announced, will remain at 95s. per quarter of 504 lb.

The crop of 1921 is the first which comes under the operation of a free market. Home-grown wheat harvested next year, that is, wheat sown in the autumn of 1920 or the spring of 1921, will not be subject to a maximum price. The effect of this will be that if, and so long as, the import of wheat is still controlled and the farmer is thereby deprived of the full benefit of a free market, he will receive for his home-grown wheat of sound milling quality, harvested in 1921, an amount equal to the average c.i.f. cost price of imported wheat of similar or comparable quality. If wheat is not controlled, he will, of course, obtain the full economic price in a free market. He will thus be entitled in any case to the parity price of imported wheat, while, if there is any big break in prices, the Agriculture Bill proposes to give him a guarantee against serious loss.

As the Minister of Agriculture stated in his speech at Rothamsted in June last* : " At whatever price imported wheat

* The speech was published in this *Journal*, July, 1920, p. 320.

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comes into this country, the farmer will get the equivalent of that price for his wheat harvested in 1921, instead of being tied down, as he has been recently, to a controlled maximum (of 95s.).'' What the average world price may be for wheat harvested next year it is impossible to forecast, but, as the Minister remarked, if the farmer is protected on the one hand against serious loss, if he grows wheat, by the minimum price contained in the Agriculture Bill, and on the other, if he is to have the chance of making his profit up to the average world's price, this should prove a sufficient inducement to bring about a largely increased sowing of wheat this autumn. He would be animated not merely by motives of patriotism, but by the fact that it will be well worth his while to do it, which, after all, is the best inducement.

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Trials of New Varieties of Winter Wheat in 1919.

(1) *Warwickshire Farm Institute.*—Trials with *Yeoman* and *Svalof Iron* have been carried out on New Red Sandstone at the County Farm Institute, Marton, Warwickshire, in the three years 1917-1919, and an average yield in the three years of 45½ bushels (of 63 lb.) of grain per acre has been obtained for *Yeoman* and 48½ bushels of grain for *Svalof Iron*, as compared with 33½ bushels of grain over the average of six years for Browick. The plot land in 1919 was very poor, and the results in that year depressed the averages of the previous two years, which were for *Yeoman* 53½ bushels and for *Svalof Iron* 59 bushels of grain per acre. *Yeoman* has stood up well in these trials.

(2) *Cockle Park, Northumberland.*—About 5 acres of *Iron* wheat were sown with a disc coulter drill in the autumn of 1917 on land ploughed out for oats in 1917; it was previously an excellent meadow which had received repeated applications of dung and basic slag. This variety threshed out at 65½ bushels per acre. The result showed that a good second corn crop can be grown without manure after ploughing out old turf which has been liberally treated, especially with basic slag.

About 7½ acres of poor clay soil which had failed for roots in 1918 and had received 15 tons of dung to the acre was summer-fallowed and sown with *Iron*, *Yeoman* and *Benefactor* wheats. No further manure was applied. The crops of grain were (per

acre) *Iron* 59 bushels, *Yeoman* 67½ bushels and *Benefactor* 66½ bushels.

(3) *The Harper Adams Agricultural College, Shropshire.*—Seventeen varieties of wheat were sown in the autumn of 1918 on a sandy loam; 10 tons of dung per acre were applied on clover before ploughing, and a top dressing of 1 cwt. of sulphate of ammonia per acre was given to the wheat in the spring of 1919. The highest yields per acre proved to be *Svalof Iron* (own seed) 54 bushels of grain, 52 cwt. of straw; *Victor* (own seed) 52½ bushels of grain, 40 cwt. of straw; *Fox* (second growing) 52 bushels of grain, 45 cwt. of straw; *Fenman* (second growing) 50 bushels of grain, 50 cwt. of straw; *Hawk* (second growing) 49 bushels of grain, 47½ cwt. of straw; *Marshal Foch* 48 bushels of grain, 45 cwt. of straw; *Browick* 48 bushels of grain, 42½ cwt. of straw; and *Yeoman* (third growing) 47 bushels of grain, 40 cwt. of straw.

(4) *Garforth, Leeds.*—Eight varieties of wheat have been tested continuously at this centre for the four years 1916 to 1919. The crops per acre over the average of the four years were:—*Victor* 50 bushels grain, 34 cwt. straw; *Fenman* 48 bushels grain, 36 cwt. straw; *Standard Red* 48 bushels grain, 35 cwt. straw; *Squarehead Master* 47½ bushels grain, 35 cwt. straw; *Benefactor* 47½ bushels grain, 34 cwt. straw; *Little Joss* 46 bushels grain, 35 cwt. straw; *Browick* 46 bushels grain, 34 cwt. straw; and *White Standup* 45 bushels grain, 33 cwt. straw.

Svalof Iron has been tested in three years, and gave a yield of grain per acre of 52½ bushels in 1916, 52 bushels in 1918, and 42 bushels in 1919 (when yields were lower).

Yeoman has similarly been tested in three years, and the yields of grain per acre from this variety have been 47½ bushels in 1917, 51 bushels in 1918 and 40 bushels in 1919.

(5) *Midland Agricultural and Dairy College, Sutton Bonington, Loughborough.*—Two tests were made on Keuper Marl with respectively 10 and 5 varieties of wheat. Seed was sown at the rate of 2½ bushels per acre early in October, 1918, and the crop was harvested on the 15th August in the following year.

In one test no manure was applied; the previous crop had been seeds, of which the aftermath was grazed by dairy cows, on land which had been top-dressed with 1 cwt. of nitrate of soda per acre. Of the varieties sown *Fenman* and *Champion* yielded each 48 bushels per acre, *Svalof Iron, Victor* and *Yeoman* each 32 bushels, and *Browick* 31 bushels. The order of ripening was:—*Yeoman, Browick, Fenman, Champion, Victor.*

In the other test a top dressing of 1 cwt. of sulphate of ammonia was given to land on which seeds had previously been similarly manured, the aftermath ploughed in and lime applied at the rate of 1 ton of shell lime per acre. The results of the four best varieties in this case were:—*Yeoman* 43 bushels, *Fenman* 42 bushels, *Svalof Iron* 39 bushels, and *Rivetts* 37 bushels.

(6) *South Eastern Agricultural College, Wye.*—Twelve varieties of wheat were sown at the rate of 4 bushels per acre on a calcareous loam which had previously been cropped with mangolds which received 15 tons of dung plus artificials. The best yields in these trials were (per acre):—*Marshal Foch* 49 bushels, *Yeoman* 47 bushels, *Hawk* 46 bushels, *Benefactor* 45 bushels, *Browick* 44 bushels, *Victor* 35 bushels, *Red Standard* 33 bushels, *Squarehead Master* and *Svalof Iron* 30 bushels.

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Soiling Crops in General Farming.

THE use of soiling crops in general farming is dealt with by Mr. J. C. Brown in this issue in a short article (p. 725) that will arrest the attention of all thoughtful and progressive farmers intent on making the most of the land. The experience of the war years has clearly shown that sound, well-drained land is capable of producing more food under arable cultivation than under grass, and with this as his text the author outlines a system of cropping calculated not only to raise the aggregate returns over a period of years, but to maintain the fertility of the land at relatively small cost.

The system is specially recommended for heavy land where a succession of forage "smother" crops would take the place of the bare fallow, and the speculative roots would serve to reinforce the pastures at the beginning and end of the grazing season, and liberate for pasturage grass land but ill adapted for hay production. Crops of pea and oat hay superior in yield and quality to average meadow hay can be obtained from arable land.

Previous articles and notes on the soiling system have appeared in this *Journal* as follows:—Farming on the Soiling System, August, 1919; Pea and Oat Hay, February, 1920; The Harper Adams Soiling Experiment, March, 1920.

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The Ormskirk Potato Trials: Report for the Year 1919.

THE Potato Trials at Ormskirk, now famous in the farming world, were first instituted by the Ministry in 1908 in consequence of the discovery made in that year that certain potatoes are immune from Wart Disease. The first trials held were of different varieties of potatoes and of the action of chemicals on the disease. In 1909 and 1910 trials were also begun by the Lancashire County Council on the grounds of the Ormskirk Union, but were discontinued after the immunity of certain varieties had been proved. In 1915 the late Mr. Snell, with the help of the Lancashire Farmers' Association, began similar trials on the same ground, and these have developed into what are now known as the Ormskirk Trials. Hitherto they have been chiefly tests for immunity, but in future cropping and other qualities of immune varieties, as well as potato diseases other than Wart Disease, will be investigated at the Potato Testing Station at Ormskirk, under the auspices of the Ministry and the National Institute of Agricultural Botany.

The Ministry has just issued the Annual Report of the Trials for 1919*—a most interesting publication, compiled by the late Mr. John Snell, Director of the Ormskirk Potato Station, and by Miss Evelyn Johnson, his Assistant. The Report notes that through the kindness of the Ormskirk Board of Guardians, the farm attached to the Poor Law Institution was lent once more for the 1919 trials. This land has shown itself to be thoroughly infested with the spores of the fungus causing Wart Disease. In 1919, owing to the great increase in the number of varieties sent for trial and the limited amount of land available, it was necessary, unfortunately, to conduct the trials on land which had been cropped with potatoes the previous year. Great care was taken, however, to remove any tubers left in the soil from the crop of 1918.

The light sandy loam of the trial grounds is such that, in order to obtain the best results, the soil should be moist at the time of planting. If the soil is dry at this time, subsequent rains do not penetrate, but run off the surface into the bottom of the ridges. In 1919 practically no rain fell until the end of June, and many early varieties gave very low yields, while second early varieties, such as Arran Comrade, matured

* Ormskirk Potato Trials. Annual Report for 1919 of the Trials of Potatoes Immune from Wart Disease. London : H.M. Stationery Office, 1s. 6d. net., post-free.

abnormally early. In the last days of June a very strong north-west gale caused considerable damage to a number of plots. It must be clearly recognised, therefore, that in many instances the yields recorded in the Report may be due to adverse weather conditions, and are not characteristic of the variety.

The land was ploughed only once, and rotted stable manure was applied at the rate of 15 tons per acre. Superphosphate at the rate of 4 cwt. to the acre and sulphate of ammonia $1\frac{1}{2}$ cwt. to the acre were also used. No potash was available. All the manures were applied in the drills at the time of planting.

The work of putting in the seed had begun during the second week of April, 1919, but certain of the plots were not complete until June, owing to delay on the part of growers in sending in their stocks. Some specimens, in fact, were not received until the third week in June. Such delay in planting does not permit the varieties to show their cropping qualities to advantage, and in future it may be necessary to fix a date after which no potatoes can be received.

All varieties were planted at a distance of 28 inches between the drills and 15 inches between the seeds, and all large tubers were cut. The Report states that the number of weak stocks sent in was very noticeable. The sprouts broke late, and were feeble and spindley. The seed did not decay in the ground, but remained hard and firm throughout the entire season. The haulm was weak and the foliage often curled, with the result that there was a poor crop of small tubers. At lifting time, some of the susceptible varieties showed undecayed sets with masses of wart attached to them, a condition not previously observed on the trial grounds. The reason of this may be that the sprouts being so late in breaking were not through the ground before the spores of the disease had become active. The sprouts were consequently attacked, and warty tissue was formed on them. As the 1918 crop was harvested under very adverse weather conditions, it is more than probable that much seed was unavoidably sweated in the clamps.

An encouraging feature of the 1919 trials was that in spite of the disadvantages under which growers have worked for the last few years, the majority of the stocks of the leading immune varieties were remarkably free from "rogues." Growers will recognise that if Wart Disease is to be combated successfully, the immune stocks must be kept free from susceptible "rogues." Stocks can be most easily "rogued" in the seed boxes when the potatoes are being sprouted ready for planting.

The badly mixed stock of Great Scot, for instance, could have been purified on the trial grounds, as it was evident at planting time that tubers with deep purple sprouts were Arran Chief, but they were deliberately planted as sent. Growers should refer to the descriptive list of the immune varieties for the colour of the sprouts. Although the degree of purity in the immune stocks was high, it was surprising to find that many of the new varieties sent for the first time consisted of very mixed stocks. The greatest care is necessary to prevent new varieties from becoming contaminated with others already in cultivation.

A notable point in the Report is the fact that during 1919, for the first time since the trials had been carried out at Ormskirk, it was observed that the climatic conditions of the season had a marked effect on the intensity of the disease. In previous years many of the more highly susceptible varieties have produced warted tubers in excess of clean tubers. During the season under review, in practically every case, the proportion of visibly clean tubers was far in excess of the warted specimens. In those varieties where the proportion of clean tubers has been, as a rule, greater than that of warted specimens, a crop of the latter was relatively much less than in previous years. The Epicure variety, for instance, of which the warted tubers gave in 1918 1 ton 12 cwt., yielded in 1919 only 3 cwt., and in another case 1 cwt. The yield of President for warted tubers fell from 3 tons 6 cwt. to 15 cwt.

During the year the Ormskirk experiments in steam sterilisation of infected soil were continued, but results were indefinite. It should be noted, however, that Professor Barker has obtained a clean crop in soil sterilised at 100°C. for 1½ hours.

The Report contains a large body of valuable information which should be of great assistance to potato growers. Among the principal features are notes on immune varieties previously tested and comparative tables showing the difference between the yield of immune and susceptible varieties, as well as an illuminating paragraph on types and synonyms. A subsidiary, but not less valuable, report is that on the cooking qualities of nine well-known varieties, but in this connection it is to be noted that the quality of a potato is largely dependent on soil. The flavour of the varieties mentioned would in all probability be different if the tubers were grown on other soils.

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THE Ministry desires to call the attention of potato growers and dealers in "seed" potatoes to the Ministry's general policy with regard to the planting of first early varieties of potatoes which are susceptible to Wart Disease in Wart Disease Infected Areas.

Planting of Susceptible Varieties of Potatoes in Wart Disease Infected Areas.

The Ministry has now issued a general licence authorising the planting of seed potatoes of any true first early varieties, and also of the variety "Eclipse" and others of that type, in land situated within any Wart Disease Infected Area, except on land on which Wart Disease has been known to occur and on condition that the produce will be used within the Infected Areas only. It will not be necessary for growers to apply to the Ministry for individual licences for this purpose.

Licences will, however, be necessary before "seed" of these varieties may be introduced into an Infected Area, whether the introducer be the actual grower or is a dealer in "seed" potatoes. Applications for such licences should be made to the Ministry at 72, Victoria Street, London, S.W.1, and should state (1) varieties of potatoes for which licence is required, (2) the quantity of each variety, and (3) the source of supply. The Ministry desires it to be clearly understood that this concession will operate until the 30th April, 1924.

The following varieties are recognised by the Ministry for planting under this concession:—Duke of York (or Midlothian Early or Victory); May Queen; Ninetyfold; Epicure; Sharpes Express; Ringleader; Eclipse; Sir John Llewellyn; Puritan. Growers wishing to plant any other varieties of true first early types susceptible to Wart Disease should apply to the Ministry for permission to do so. No other susceptible varieties of potatoes may be planted in any Infected Area in any circumstances.

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OWING to the great loss caused in certain districts by "Corky Scab," the Ministry undertook a series of small trials this season to ascertain if there were any varieties which did not contract this disease. Most of the varieties tested were those which are known to be immune from Wart Disease. "Sharpes Express," a susceptible variety, was also tried at one of the centres. It is to be regretted that in no case did the variety fail to take the disease. Although the resistance to it

Corky Scab of Potatoes.

varied somewhat at one centre, the intensity of the attack was very severe, and every tuber of " Great Scot " was attacked; " Golden Wonder " and " Flourball " were almost as badly affected, only two or three of the tubers being visibly free. In this test " King George " was not so badly attacked, but even here the disease was serious, 80 per cent. of the tubers being affected, but not severely. On another plot where " Great Scot " was attacked to the extent of 95 per cent., " Templar " had 60 per cent. of tubers affected.

The above trials took place in Derbyshire, but a trial at Gisburn in the West Riding gave a lower percentage of disease. In this case, however, it was evident that the soil was not infected to such a great extent as in Derbyshire. All varieties were attacked, varying from " Edzell Blue " with 30 per cent., down to " Ally " with 5 per cent., and " Templar " with 4 per cent. of tubers affected.

In each case the soil was heavy and constantly damp, and it is known that under these conditions, more especially when lime is present, the scab has its greatest opportunities of development.

Further experiments are contemplated next season, when it is hoped that both drainage and chemical trials may be undertaken.

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Restocking of Bees Scheme.

THE outstanding feature of the bee-keeping industry during the past few years has been the serious depletion of the number of stocks of bees in the country, owing to the so-called " Isle of Wight " disease. This disease was first noticed in the Isle of Wight in 1904, and in 1909 it spread to Hampshire and to the mainland generally. By the year 1918 the stocks had dwindled to such a serious extent that the Ministry decided to inaugurate a scheme to re-establish bee-keeping, and, if possible, to increase its extent. In order to do this it was essential not only to replace the stocks that had been lost, but to introduce a race of bees possessing some degree of resistance to Isle of Wight disease. Experiments which had already been carried out demonstrated that the Italian Bee possessed this power of resistance to a large extent. Investigations into the results of these experiments were undertaken by the Ministry's Technical Adviser on bee-keeping, and, these proving satisfactory, the Ministry decided that the main feature of the

Restocking Scheme should be the introduction of the Italian Bee.

Owing to regulations in force in Italy, however, the exportation of stocks of bees from that country was prohibited, and it was possible only to introduce Italian Queen Bees. It was therefore necessary to import from another country the stocks of bees required for the production of nuclei, or miniature stocks, to which the Italian blood would subsequently be introduced. Dutch bees were chosen for this purpose for two reasons—(1) because of their great powers of increase, by reason of which the production of nuclei would be accelerated, and (2) because they were the survivors of a serious attack of bee disease in Holland some seventy years ago, and therefore were possessed of a certain immunity from Isle of Wight disease.

To assist in the work of restocking, County Horticultural Sub-Committees were asked to form Bee Committees for their counties, to deal with the establishment of Restocking Apiaries for the rearing of nuclei and the subsequent introduction of the Italian blood. This request was responded to by 28 of the counties in England and Wales.

268 Dutch stocks were ordered, and these were brought to this country in April, 1919, without the loss of a single colony. The bees were not in modern movable comb hives, but in conical straw skeps about 2 ft. high. 251 were distributed to the above-mentioned Bee Committees, and the remainder were forwarded, also for restocking purposes, to the Irish Department of Agriculture and Technical Instruction, and to private bee-keepers, who, having heard of the proposed scheme, desired to participate, if the Ministry should have any surplus stocks in hand. In some cases the bee-keepers transferred the bees to movable comb hives, but in others the original straw skeps were retained and are still being used.

700 pure fertile Italian queen bees were ordered from a reliable queen rearer, and were delivered in consignments by registered post during the period May-August. Each queen bee travelled in a small wooden mailing cage having a chamber for bee-food, and was accompanied by a few worker bees for the purpose of feeding the queen during the journey and the period of segregation necessary before actual introduction to a new hive. 408 queens were despatched to the Restocking Apiaries, and the remainder to private bee-keepers.

During the summer, a total of 1,171 nuclei, each of which

was headed by an Italian queen reared from the imported queens, were raised at these Restocking Apiaries, and, with the exception of a few that were reserved for the following season's work, were distributed to participators in the scheme. This means that during 1919 the stocks of bees in this country had been renewed to the extent of about 1,500. These Restocking Apiaries were examined during the summer by the Ministry's Technical Adviser, and, with the exception of three only, were found to be well managed.

This initial success was a sufficient indication of the advisability of continuing the scheme in the future. For this to be successful, however, it would be necessary to continue, year by year, the importation of Italian queen bees for distribution to the Restocking Apiaries, in order that the stamina and disease-resisting quality should be maintained. Subsequent in-breeding would considerably weaken this strain, and would ultimately annul the good results already achieved.

Arrangements were accordingly made for the importation of a supply of Italian queen bees during the summer of 1920. The demand proved considerably greater than was the case the previous year, and it was found necessary to order a total of 1,600 queens.

Five additional counties agreed to carry out the Ministry's Scheme, owing to the successes achieved elsewhere. It was decided that no Dutch stocks should be requisitioned for these counties, but that the Committees should be asked to make their own arrangements for procuring the necessary stocks to form the basis of the Scheme.

The delivery of the queen bees this year commenced somewhat later than was expected, owing to postal and railway difficulties in Italy, and as a consequence, it was necessary to reduce the order to 1,555, a number of bee-keepers wishing to cancel their applications. The queens were received at intervals and re-despatched from the Ministry during the period May-September.

The results of this season's work at the Restocking Apiaries are not yet reported, but it is anticipated that a larger number of nuclei will have been disributed than was the case in 1919. A proportion of the nuclei sent out will be kept under observation, and it is hoped that in this way valuable information will be obtained as to the manner in which the imported bees have been able to adapt themselves to the climatic conditions of this country.

The scheme provides for the continued rearing and distribution of nuclei, and, with the annual importation of Italian queen bees, it is hoped that in a few years' time the bee-keeping industry of this country will have been re-established on a sound basis.

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Importation of Canadian Store Cattle.

THE Rt. Hon. The Lord Lee of Fareham, G.B.E., K.C.B., Minister of Agriculture and Fisheries, received, on the 30th September, a joint deputation from the Scottish Chamber of Agriculture and the National Federation of Meat Traders' Associations, urging the removal of the existing embargo on the importation of store cattle from Canada.

Sir Isaac Connell, Secretary of the Scottish Chamber, briefly introduced the deputation, and observed that since the War there had been a distinct change of view on this important question.

Mr. J. E. Esslemont, a Director of the Chamber, in stating the case for the deputation, recalled the fact that the existing prohibition was imposed by legislation in 1896, with the express purpose of preventing the spread of disease in the herds of this country. At the present time, however, not only was the position with regard to disease entirely changed, but also the situation with regard to meat. Though, hitherto, this subject had been debated from the contending points of view of the feeder and breeder, it had now become a consumer's question. As disease was non-existent in Canada, it was unfair to maintain any longer what was, in effect, preferential or protective treatment in favour of one branch of the agricultural industry, under cover of an Act to keep out disease.

It was admitted that the Canadian frontier of 2,000 miles was no barrier against disease from the United States, though Scottish breeders, who were disposed to press this point, were oblivious of their own protests when an outbreak of disease in Yorkshire was considered likely to affect the export of pure bred cattle from Scotland. Moreover, all pedigree bulls exported to Canada had to pass the tuberculin test, leaving bulls that did not pass the test to breed from in this country. By removing the embargo we would therefore be importing an even healthier class of cattle than our own. The supply of beef would be increased, and an increased output in this, as

in other commodities, would mean a reduction of prices to the benefit of the consumer. There was, further, no better way of maintaining the fertility of the land which had been brought under the plough during the War than in consuming the increased crop by feeding cattle. Assuming freights remain as they are, imported stores would cost less than the present price of the home-grown animal, and, when finished in this country, would mean much better beef than the imported dead meat, whilst the subsidiary occupations connected with slaughter and the hides would result in material benefit to the country in general. Finally, and most important of all, there was the Imperial aspect of the question, which demanded the removal of the existing restrictions in the interests of the good relationship between Canada and the Mother Country.

Councillor T. Masheter, J.P., President, National Federation of Meat Traders' Association, in supporting, drew attention to the great demand for fresh meat in contrast to that for the imported article, and submitted that the existing shortage of cattle and sheep in this country was abundant necessity for increasing the supply of store cattle. There was reason to believe that freights would, in future, be considerably lower than at the present time.

Alderman F. A. Cox, President-elect of the Federation, observed that it had been stated that the embargo was maintained in the interests of Irish exporters, and contended that any such preferential treatment was unjustifiable. The principle of the importation of cattle from Canada had, however, already been accepted by the Ministry in connection with Friesian cattle, and he submitted that the period of quarantine then imposed might be considerably reduced in favour of stores. The requirements of the United States for Canadian store cattle would probably grow less and less, which would stimulate the desire of Canadian exporters to find a market in the Mother Country.

Mr. H. A. Adams (Executive Committee of the Federation), reminded the Minister that it had been understood that the embargo would in any case be removed at the termination of the War.

Councillor J. Edwards (Executive Committee of the Federation), drew attention to the great and increasing demand for milk, on the one hand, and for fresh meat on the other, and submitted that these demands were irreconcilable and could not be met without the liberal importation of store cattle.

Lord Lee, in reply, reminded the deputation that there was very far from being agreement on this important question amongst the societies and interests concerned, in Scotland as well as in England and Wales. There had been, however, no political representations of any sort or kind, the issue being decided purely on its merits as it affected the interests of the country, and particularly the agricultural interest. It would, admittedly, be wrong to take advantage of legislation, passed to protect the flocks and herds of this country against disease, for fiscal or other purposes at other times, but the statement that the position as regards disease had now entirely changed could not be accepted in view of the facts. While there was no specific charge against Canadian cattle, the record of which was one of the cleanest in the whole world, yet the incidence of the various diseases was so obscure, their vagaries so infinite and surrounded with mystery in every shape and form, that it was not possible to import live stock from any quarter of the globe without, at the same time, incurring a certain definite risk of disease. The recent outbreak of rinderpest in Belgium was a case in point, due to live cattle from America in transit, and actually at the docks at Antwerp, coming into contact with a cargo of Zebu cattle passing from India to the Argentine. So far as foot-and-mouth disease in this country was concerned, a scientific inquiry of the most thorough kind had been recently set on foot by the Ministry to endeavour to discover the real nature of this disease and its means of communication.

Meanwhile, among those who held the opposite view to that of the deputation, there was the strongest possible feeling that the only real protection that we had at present was our insular position and the maintenance of the isolation it afforded. The permission given by the Department some time ago for the importation of certain exceptional Friesian cattle from Canada did not bear on the main question. In that case the conditions imposed, including prolonged quarantine, were not only so severe that no cattle had yet come in, but they were such as would make the proposal to import store cattle economically impossible and even ridiculous if a similar procedure were applied.

Mr. Esslemont had urged that, owing to the increased acreage under crop, it was essential that there should be more stores. The facts, however, were that, owing to existing labour conditions, the arable acreage was rapidly shrinking in Scotland as well as in England, and the war-time increase

was not being maintained. In these circumstances, it was to be regretted that, on its own merits, this argument could not be accepted. The claim had also been made that imported stores would mean better and more beef and the advantage of the offals and subsidiary occupations. With regard to better beef, that was open to argument, but with regard to the other points there was, of course, nothing to prevent the importation of Canadian cattle for immediate slaughter at the ports, which would increase the supply of fresh meat and secure the other advantages referred to. The statement that Canadian stores could be imported economically in competition with the home article was, in any case, open to considerable doubt. Apart, however, from these considerations, the main point to be realised was that the existing embargo could only be removed by fresh legislation, and there was little chance, under present circumstances, of Parliament giving its consent to any such measure. With regard to the Imperial aspect of the question, this had been taken up by the Canadian Government, but though no one could be more anxious than he, not merely to maintain, but to strengthen the ties which bound Canada to the Mother Country, it would not really help matters to gratify Western Canadian sentiment at the expense of injuring and antagonising the British farmer.

After the most careful and impartial consideration he felt bound to agree that, in view of the risk involved, the best possible security was that same moat which had surrounded these Islands and protected them from every kind of invader, including disease, for so many centuries, and he regretted to have to say that, in his judgment, the arguments that had been put forward, in favour of removing the existing safeguards, were far outweighed by the gravity of the objections which would be urged by the other side.

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The Humane Slaughter of Animals.

THE Ministry desires to impress upon all concerned the importance of ensuring that animals are slaughtered in a humane manner. Since the Commission, over which the present Minister of Agriculture presided, sat in 1904, there has been a steady awakening of the public conscience and a definite improvement in methods of slaughter, but there is still room for improvement, and the efforts of associations that seek to deal with the matter have not availed to introduce into this country the abattoir system which prevails on the Continent

and has done so much to make slaughtering humane. There are many private slaughter-houses over which the supervision is unsatisfactory and incomplete, and the Ministry is urging upon butchers throughout the country the advisability of killing by humane methods.

While the pole-axe in the hands of a skilled man is admittedly most effective, the requisite skill can only be acquired by practice. Young animals should always be stunned. The ordinary methods of killing, especially in the case of calves and pigs, leave much to be desired, and instructions have recently been issued to the Ministry's Inspectors to take steps to ensure that slaughtering on account of outbreaks of disease is carried out humanely, and by the aid of either humane killers or, in suitable cases, shot-guns. Officers who are compelled to slaughter animals (as in cases of foot-and-mouth disease) are also instructed to employ the most humane methods, and are further charged to see that any butchers employed by them are to observe the same principles. The Minister has in addition given instructions that all officers of the Ministry are to regard themselves as propagandists of humane methods of slaughter throughout the country, and laid it down that the main principle to be kept in view by all concerned is that every animal should be properly stunned before it is bled.

There are several humane killers on the market, and the Ministry has adopted one by Messrs. Greener, of Birmingham, which takes the form of a pistol firing a 0.22 hollow-nosed bullet, in cartridges both long and short, and is, generally speaking, capable of stunning sheep and pigs up to 24 stone in weight. In the case of small pigs or lambs, where the charge may emerge from the skull, or where the animal is being killed for food, it should be stunned with a suitable hammer or mallet. Where affected cattle are to be destroyed in the preliminary stage of an outbreak of foot-and-mouth disease, veterinary surgeons are advised to employ a shot-gun, because the effect of a charge of shot is immediate, the charge entering the brain as a solid mass and immediately spreading, thereby destroying all sensation.

The widest publicity is sought for these principles of humane treatment of animals, so long neglected in this country, and it is hoped that people who find themselves in agreement with the view taken by the Ministry will do all in their power to urge the cause of humane treatment in the slaughter of animals. It is only by the united action of all who are concerned

with the proper treatment of our livestock that improvement in the existing conditions can be brought about.

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The Export of Decrepit Horses.

SOME misapprehension still appears to exist as to the character of the present trade in the export of horses. Before the outbreak of war in 1914, the only control exercised was that provided by the Diseases of Animals Act, 1910, which prohibited the shipment from any port in Great Britain to the Continent of Europe of any horse, ass or mule, unless it had been examined by a veterinary inspector appointed by the Ministry and certified in writing by him to be capable of being conveyed and disembarked without cruelty. It must not be supposed, however, that the veterinary examination of horses for export, under the Act of 1910, was indifferently carried out; on the contrary the examination was rigorous and a high standard of fitness was enforced, with the result that complaints from the Continent as to the condition in which the animals reached the port of debarkation had practically ceased. Nevertheless, many of those interested in the humane treatment of animals considered that the trade in worn-out horses should be prohibited altogether. This view was embodied and made law in the Exportation of Horses Act, 1914, which took effect on the 1st October of that year.

In view, however, of the Royal Proclamation of the 3rd August, 1914, which prohibited the exportation of animals (including horses) on the outbreak of war, the general export trade in horses ceased for the time being. It was not until October, 1919, in response to demands from the Continent for horses suitable for agricultural and other work, that the trade in horses was resumed. Not until the latter date, therefore, did the Act of 1914 come into active operation. That Act prohibited the shipment of horses from any port in this country unless certified by a veterinary inspector of the Ministry, after examination immediately before shipment, to be capable of being conveyed and disembarked without cruelty, and also of being worked without suffering. The Act also empowers the veterinary inspector to slaughter, without the consent of the owner, any horse presented for examination and found by the inspector to be in such a physical condition that it is cruel to keep it alive, or that it is permanently incapable of being worked without suffering.

Arrangements have been made by the Ministry at the following ports for the veterinary examination of horses before export, namely :—London, Folkestone, Harwich, Hull, Grimsby, Goole, Leith and Southampton. Explicit instructions have been issued by the Ministry to its veterinary inspectors, in order to secure that in no case are horses to be shipped unless their standard of fitness for work fully complies with the requirements laid down by the Act of 1914. When the trade was first resumed in the autumn of last year, a number of horses were brought forward for shipment which were obviously below the standard required. These were rejected, and a large number of them at once slaughtered at the ports.

It is perhaps not generally known that the Horses (Importation and Transit) Order of 1916, made by the Ministry, prohibits the carriage by railway or by water of any horse, ass or mule which, owing to infirmity, illness, injury, fatigue, or any other cause, cannot be so carried without unnecessary suffering. Local authorities and police are empowered to detain any unfit horses which are intended to be so carried, and both these authorities and the railway companies are fulfilling the requirements of the law in this connection.

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The Keeping of Small Live Stock by Allotment Holders and Householders.

THE experience of recent years has proved the value to the nation both of small cultivation and of small live stock keeping. The latter industry, combined with allotment work, has proved itself to be a most valuable auxiliary; and even where the breeder has no other accommodation than his backyard, the keeping of poultry and rabbits can be successfully undertaken, where the accommodation provided for the animals is in accordance with the requirements of the Local Sanitary Authority. Where space is sufficient and other conditions are satisfactory, the keeping of pigs has also proved profitable. The necessities arising from the food shortage both in this country and throughout the world make it urgently advisable to encourage to the utmost both small cultivation and live stock keeping. There is the further point that, in view of the enormous imports into this country of poultry, eggs and bacon, there is an economic opening for an immediate increase in the home production. The imports last year of poultry produce alone, for instance, are valued approximately at £35,000,000.

Where live stock is kept, it is of course essential that local sanitary requirements shall be observed. When cultivators fulfil these requirements, which should be ascertained in cases of doubt by application to the Local Sanitary Authority, no objection can be taken to their pursuits on the grounds of hygiene.

Recently, however, a question has arisen in connection with the keeping of live stock by private persons which calls for some clearer public information. It would appear from a number of letters received by the Ministry, that cases occur in which landlords do not view favourably the maintenance of small live stock by their tenants. Provided, however, that the stock can be kept under suitable sanitary conditions and without danger to public health or interference with the amenities of the district, proprietors can hardly have sufficient reason for objection in view of the present needs of the country.

The question is admittedly delicate, and as investigation into particular cases is entirely a matter for the Local Authorities and landlords concerned, the Ministry does not consider that the matter calls for any official intervention on its part. It desires, however, to clear away any possible misunderstanding that may stand in the way of increased production of food supplies. Recognising the importance of private effort in this direction, the Ministry would remind owners of property of the importance of increasing the supplies of home-grown food, and desires to point out that the keeping of live stock not only replenishes the national larder and reduces imports, but is a great preventive of waste, as the stock converts much kitchen and garden refuse into valuable human food. It is therefore hoped that where tenants of houses and allotments maintain or are prepared to maintain poultry and small live stock under sanitary conditions, the owners of such property will give their tenants every reasonable opportunity of doing so. Tenants on their part are advised urgently to take all proper care to keep their stock in sanitary condition, and to do nothing to warrant any restrictive action on the part either of their landlord or the local Health Authorities. The Ministry seeks to afford poultry keepers and small live stock breeders all possible support and encouragement.

Wide publicity is being given to its wishes in this matter, and the Ministry, in putting the case before Local Authorities and property owners, asks that they will not definitely prohibit the keeping of pigs, poultry and rabbits, but will permit it

when and where it can be carried out under suitable sanitary conditions and without danger to public health or interference with the amenities of the district.

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Agricultural Wages Board.

AT a meeting of the Agricultural Wages Board on the 23rd September, Mr. Acland presented a report from the Board's Committee on "Cottages," which was unanimously adopted. This report had been specially prepared in consequence of the request of the Minister of Agriculture that the Board should reconsider their policy of allowing the provision of a cottage to a worker by his employer to be recognised as a "benefit or advantage" in part payment of minimum wages in lieu of payment in cash. It gives a considered presentation of the whole position from the Board's point of view, and recommends that the Board adhere to their previous policy in the matter.

The report sets out, in some detail, the action which the Board has taken, with the reasons which influenced them, and also gives reasons for their adherence at the present time to the same policy. It will probably be of use to many persons throughout the country who have failed to appreciate the exact effect of the Board's Order, and its relation to the provisions of the Increase of Rent and Mortgage Interest (Restrictions) Act. It brings out clearly the point which is sometimes overlooked, namely, that the Orders of the Board have no direct bearing on the rents of cottages other than cottages which are provided by the employer to the worker as part of the contract for his services. Where farm workers live in cottages which are not held from the employer, such cottages do not, of course, come within the scope of the Board's Order. The report is published in full in the issue of the *Wages Board Gazette* for 1st October, 1920.

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National Rat Week.

IT has been decided to hold a fourth National Rat Week from the 1st to 6th November. The object of these rat weeks, as may be generally known, is to secure, by organised and simultaneous action throughout the country, the largest possible destruction of rats. The responsibility for the destruction of rats rests by Statute upon the occupiers of premises, and it is hoped that farmers will take part in these periodical rat weeks, which should, if supported by the united action of the com-

munity, do much to remove or greatly reduce the damage caused by the depredations of these vermin.

Previous references to National Rat Weeks held in the country appeared in this *Journal*, September, 1919, pp. 579 and 628; November, 1919, p. 770; December, 1919, pp. 867, 927 and 933; and March, 1920, p. 1179.

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Importance of Sowing Clean Cereal Seed.

IN the present need for increased wheat supplies, it is important to aim at a larger yield per acre. To attain this end, not only should improved varieties be sown and adequate manuring and cultivation methods be adopted, but care should be taken to sow clean seed in order to avoid as far as possible subsequent trouble from weeds.

In this connection a report has been forwarded to the Ministry by Mr. John Porter, Agricultural Organiser for Buckingham, in which it is pointed out that rye-like brome grass (*Bromus secalinus*) is overlooked by many farmers, and by others is considered to be a species of wild cereal. This obnoxious weed has made its appearance in winter cereals both in Buckingham and Hereford, very possibly owing to the seed having been present in the seed grain.

Mr. Porter points out that where farmers who grow cereal grain for seed have this weed in a crop, they should open the screen of their threshing mill a little wider when threshing; the seeds of this weed, being of about the same size as tail wheat, would be sifted out with the latter. The sample of grain would be improved and a higher price obtained, and the weed seeds could either be ground down for feed or fed to poultry.

Farmers who are in the slightest doubt as to the purity of their seed grain should consult their County Agricultural Organiser.

NOTES ON THE LINCOLN TRACTOR TRIALS, 1920.

THOMPSON CLOSE, B. J. OWEN, B.Sc. (Eng.), and H. G. RICHARDSON, M.A., B.Sc.

THE recent trials of farm tractors at Lincoln were organised by the Royal Agricultural Society of England in conjunction with the Society of Motor Manufacturers and Traders, who were responsible for the highly successful trials of last year. The trial ground was in close proximity to that chosen in 1919, and presented very similar features. The chief difference between the two trials was the method adopted by the Royal Agricultural Society of placing machines in a definite order of merit and awarding gold and bronze medals. In certain classes where the competitors numbered only three (some reduced to a single tractor), two and one, this method had an air of unreality, and the competition was in effect restricted to classes 1, 2 and 7.

Entries were accepted under seven classes, which are set out below. It will be observed that there were three classes for internal-combustion tractors, one for steam tractors, one for "self-propelled ploughs," and two for cable sets; the last-named, it will be recalled, did not figure in the 1919 trials.

Class 1.—Internal Combustion Direct Traction, not exceeding 24 H.P., suitable for ploughing two furrows 10 inches wide by 6 inches deep.

Class 2.—Internal Combustion Direct Traction, not exceeding 30 H.P., suitable for ploughing three furrows 10 inches wide by 6 inches deep.

Class 3.—Internal Combustion Direct Traction, over 30 H.P., suitable for ploughing four furrows 10 inches wide by 8 inches deep.

Class 4.—Direct Traction Steam Engine, suitable for ploughing four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 5.—Internal Combustion Double Engine Set, with wire rope haulage for ploughing three or four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 6.—Double Steam Engine Set, with wire rope haulage for ploughing three or four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 7.—Self-propelled plough for ploughing not more than four furrows of not more than 10 inches wide by not more than 8 inches deep.

Design.—Among the machines competing in the various classes there was striking uniformity in design and construc-

tion, although it is possible to divide the whole of classes 1, 2, 3 and 7 into two main types:—

(*a*) Those in which the whole of the machinery is built up in one block of casting, *i.e.*, there is no frame;

(*b*) Those in which there are separate units on a frame. Broadly speaking, very little difference was observed between the machines which competed this year and last year. It would seem as if for the time being the manufacturers regard design as having reached finality, and are content with minor improvements. In this connection it may be remarked that manufacturers and designers have naturally been strongly influenced by the example of horse ploughing, and have regarded the tractor as a substitute for the horse. This, and the fact that the motor car and tractor industries are closely linked, may have led to the neglect of the possibilities of the conversion of power into rotary motion; the problem is engaging the attention of French manufacturers and will require close investigation in this country. It is one, however, in which the question of the act of cultivation cannot be separated from the question of the tractor, a point to which reference is made later.

Weight in Relation to Horse-power.—In the more recent designs of tractor there has been a tendency to reduce weight per horse-power, and it was worth noting that the Fordson Tractor—the lightest of all—is only 1 cwt. per horse-power, as compared with 3 and 4 cwt. per horse-power in the case of heavier machines. It is evident, however, that the whole question of weight in relation to horse-power is at present little understood. Weight per horse-power should be, and undoubtedly will be, universally regarded as a necessary element in the selection of a machine for any particular class of work, and though this factor is already ascertainable and will presumably be indicated in the report to be issued on the trials, farmers in general have no idea of what it means in actual practice or its relation to their problems.

Caterpillar-track Machines.—Another problem is that of the relative efficiency of wheels and caterpillar track. Reference was made to this subject in the comments on last year's trials in the issue of this *Journal* for October, 1919. No definite opinion can be stated until a very protracted test is made under more varying conditions than those which prevailed this year. The caterpillar type is intended to avoid undue weight on the land. The general features of the

design are too familiar to need description. The principle is to reduce the insistent weight on each square inch of the land on which the creeper stands, and also to present a very large area for gripping or adhering to the ground. Results so far have demonstrated the superiority of the caterpillar tractor over the wheeled tractor on wet soils, where the track machine, with its low intensity of pressure upon the soil, shows itself to greater advantage than on a dry light soil. The wheeled machines practically group themselves in efficiency more or less in proportion to the weight per square inch carried, on the contact with the ground. It was clearly demonstrated in last year's trials that heavy weight is not necessary to provide tractive effort, and that, with efficient forms of grip, light machines are successful.

Many designs of caterpillar track exist, and a discussion of the merits and demerits of each would require a very lengthy statement. There is, however, considerable room for improvement in the chain track itself, as well as in its supports and anti-friction devices. The variation in resistance to haulage and to work is as great as exists between one system and another, not merely in static resistance to starting but in dynamic resistance to haulage. There is ample scope here for investigation and comparative tests at the hands of any research association or institute that may be established in connection with agricultural machinery.

Adhesion.—Adhesion depends for its effectiveness on three conditions: (1) the amount of wheel or track in contact with the ground; (2) the kind of gripping devices attached to the wheels or track; and (3) the weight of the machine. The second point, to which attention was drawn last year, especially needs further investigation. Various methods are now employed to obtain the adhesion necessary. They fall into three classes:—

(1) Angle iron at an acute angle on the rim of the wheels;

(2) Projecting angle iron at an acute angle to the wheels;

(3) Variously shaped spuds or spikes.

Each class employed at the trials seemed to do its work fairly efficiently, but sufficient data are not at present obtainable for comparison. There is undoubtedly considerable variation both in the adhering power of and the resistance exerted by the different devices, and a searching test should be carried out to ascertain the effectiveness of each type.

Tractor Wheels in Furrow.—While it may be doubted whether it is in every way desirable to have one of the tractor wheels running in the furrow, it was observed that when this is the case the tractor is more or less self-steering, and allows the operator to direct more attention to the plough. The furrow wheels, however, should be of such a width as not to necessitate the making of too wide a furrow.

New Improvements and New Machines.—It is not necessary to give a detailed description of the machines which took part in the trials, particularly since the great majority were competing last year. It may be remarked generally that a good deal of attention has evidently been given to points of detail with a view to ease in handling and saving of wear-and-tear.

With one or two exceptions all machines included brakes, and attention has been paid to springing. There were very few exposed gear drives, and in most instances vital parts were fully enclosed, although with due regard to the need for accessibility. In most machines provision had been made for alteration of drawbar connection in a horizontal direction, but all had not been provided with easy adjustment in a vertical direction, and those not so provided suffered in consequence.

Another point to which some manufacturers had paid attention was the application of a spring appliance for minimising the strain on the machine when the plough struck an earth-fast stone. A release device might have been incorporated with this appliance, to detach completely the plough under the strain of a heavy shock. Such an appliance should, however, be an integral part of the tractor, and not merely a casual device inserted in the drawbar connection.

Many machines were obviously too complicated for the ordinary farm hand, and the advice given last year, by a well-known farmer, that tractors should be made simple to suit the simple folk in the country, may well be repeated. A remarkable feature possessed by a self-contained machine may be mentioned: it had an electric outfit of a complicated design, which would necessitate handling by an expert mechanic, and the ordinary farm hand would be helpless at the slightest mishap.

Certain of the machines competing for the first time call for a few words of comment. In this connection it may be remarked that a well-known name is no evidence that a machine is designed on the same lines as a namesake of

earlier years; a complete change of design has been adopted in several instances where the old name has been retained.

In Class 1 the new machines were the British Wallis, the new Saunderson, the Case and the Samson—two British and two American.

The British Wallis is a modified and considerably improved pattern of the old three-wheeled American Wallis. The most obvious alteration has been the addition of another wheel, making it a four-wheeler, but there are many other detailed modifications, which add to its usefulness. The other British machine, the Saunderson, is, as regards the general principles of its design, a replica on a smaller scale of the standard model " G " tractor of the Saunderson Company. It has the same two-cylinder vertical engine and arrangement of clutch, gear-box and final drive.

The Case comes from a well-known American firm, and the machine is very original in detail design from front to rear. One-piece cast frames have been used previously, but never on the style of this machine, in which an extremely strong cast-iron member runs from front to rear, carrying on its front end the radiator; the engine is disposed midway across the frame which, at the rear, serves also to support a gear box and axle case. The Sylphon Thermostat is a useful feature of the Case. It is a device, controlled directly by the heat of the engine and cooling water, which operates to bring the engine itself, when starting from cold, rapidly to the temperature at which it will best vaporise fuel, and maintains it at that temperature throughout the whole period of its working. This effect is attained by means of a valve, which is opened or closed as the temperature of the cooling water rises and falls, and which, when closed, throttles the circulating water pipe between engine and radiator, and thus controls the amount of cooling water which passes to the engine.

The other new American machine in Class 1, the Samson, resembles externally the Fordson. An interesting feature in this machine is the lubricating arrangement. There are only a couple of holes through which oil need be poured occasionally; no other attention of that kind is necessary. The Samson is of the type of machine in which the engine and transmission case are bolted together to form one complete unit which acts as the frame of the chassis.

In Class 2 there were twenty-one machines, and of these no fewer than eight were making their first appearance in

trials in this country. Of the eight, three were of British manufacture, one was Canadian and the remaining four were American.

The British machines were the British Wallis, the Peterboro and the Pick. The first has already been referred to in Class 1. The Peterborough is designed and constructed on excellent lines. The Pick resembles, in general design, the Austin and Fordson types. The most noticeable feature is the overlapping strakes which are embodied in the back wheel construction. This arrangement is cast solid with the main body of the wheel. So designed, the wheel, even on sticky soil, remained unchoked.

The Canadian machine, the Chase, has several interesting features. It is three-wheeled, without the disadvantages usual in that class of machine: it is easily manœuvred on the headlands by eliminating the differential gear and putting the drive on the two rear wheels under the control of the operator, who can, therefore, when turning the headlands, declutch the inside wheel and drive only on the outer.

Among the American machines, the Case is a larger edition of the model entered in Class 1. The Hart Parr is entirely new. The principal point of interest is in the engine, which is a two-cylinder, slow-running horizontal unit, transmitting through a clutch and series of plain spur wheels to the differential on the rear axle. The frame of this machine is also, in the main, a casting made extremely strong with the object of eliminating any risk of distortion.

The Twin City, another new machine, is an American product with an unusual feature in the engine; it has four valves to each cylinder, two for induction and two for exhaust. In designing the frame the manufacturers have made an interesting departure; the frame serves as a casing for the transmission gear, but does not actually form a part of the engine, which is suspended within it.

The Parrett tractor attracted considerable attention, mainly on account of its somewhat unusual appearance, caused by the large diameter and the wide spread of its wheels. This construction has a decided advantage at the headlands, since it considerably facilitates the turning operation.

Performance.—A detailed review of the trials must necessarily await the report of the Judges, but the present opportunity may be taken to give the impressions that were received in watching the machines at work.

The ploughing tests were easily performed on the light land by all classes of machines. Every machine appeared to complete its work in practically the same time, and the result approached a fairly high standard. In the case of the ploughing on heavy land the large number of competitors did not permit of each class working the same field. The competing tractors were put to work in three fields, and there was a considerable difference between them in the strength of the soil. The light machines in Class 1 found the work difficult, and, in fact, failed to plough at the required depth. The water in their radiators appeared to be constantly at boiling point, and often the draught registered per furrow in this land was as heavy as 900 lb., sometimes reaching 1,000 lb. The machines were incapable of pulling a constant load of over 600 lb. per furrow with three furrows. Undue strain was evident upon the machines, and the representatives in this class certainly took a serious risk in attempting this heavy task. The performance of other classes in the ploughing competition calls for no special comment, and will be discussed in the article which it is proposed to publish after the Judges' Report is issued.

The trial included a barn-yard machinery test, which appeared, however, to be limited to a brake load test equivalent to the power necessary to drive a 4 ft. 6 in. threshing drum. The object was clearly to ascertain roughly whether a machine was capable of driving farmyard machinery. To give results of real value, however, it would be necessary to arrange a comprehensive brake horse power test, including the determination of rated load, varying load, maximum load and half load, in relation to fuel consumption, horse-power, hours per gallon, &c. It must be recognised, however, that such a test would require more equipment than was on the ground.

A hauling test was conducted on a hilly road of good surface with a fairly sharp gradient. Many failures occurred, due invariably to the wheels slipping, and not to lack of power. Many of the machines were not equipped for such a test, and ran on smooth wheels, sometimes failing on a gradient of 1 in 9.8. Machines equipped with wood blocks and rubber treads found no difficulty in ascending the hill.

Various other tests were made to show the efficiency of the machines under all conditions.

Self-contained Machines.—It was observed that these machines were regarded very favourably by many attending

the trials. The extreme facility with which they can be steered and handled makes them suitable for short headlands and small fields. Last year the report of the judges showed a very high fuel consumption, which was disappointing, and it is to be hoped that an improvement will be indicated in the forthcoming report.

Cable Sets.—Comment has been reserved on the cable sets, which provided a new feature for this year's trials. The steam set does not require special description, but the two internal combustion sets, one manufactured by Messrs. Fowler and the other by Messrs. McLaren, deserve notice. The former is a powerful machine, each unit being a 60 H.P. petrol engine of conventional type, mounted in the usual position in front, with the shaft longitudinal. The winding drum is underneath, as in the familiar steam model, and the whole plant is very substantially built. The McLaren set is a lighter machine embodying a different design; a form of windlass at the rear did the duty of the customary suspended drum.

These equipments are likely to be highly favoured in countries where difficulties are met with in providing coal or wood fuel and a suitable water supply, and where there is an ample supply of oil fuel. It will be interesting to observe whether there is any tendency for oil to displace steam in cable ploughing in this country, but it is understood that the manufacturers have the foreign market in view, at least to a very large extent. In any case, no comparison can be drawn between the cable sets and the mobile tractor, as their work falls in entirely different classes, and only very exceptionally can they ever be in competition.

Costs.—It is to be hoped that in their report the judges will remark upon the relation of cost to units of power. The prices of tractors and self-propelled ploughs vary from about £300 to £600; but the capital expenditure is only one factor, and fuel consumption and general upkeep are points to which farmers need to pay the closest attention. It is true that in a trial of brief duration running costs cannot be estimated with any close degree of accuracy, but the facts elicited over the nine days of the trials may yet be of some assistance in establishing a basis of comparison between machines.

Conclusions.—The awards of gold and bronze medals were announced at the conclusion of the trials, and have been published in the press. Without disparaging in any way

the machines which were distinguished by the judges, it may be questioned whether the awards will in any way assist either prospective purchasers of tractors or the tractor industry. Until the judges' report is published it is, of course, impossible to know what were the precise points of superiority upon which the awards were based, but from the nature of the regulations and tests and the duration of the trials it is certain that factors which are of supreme importance could not be taken into consideration. It is very questionable whether under any conditions the competitive element is a desirable ingredient in scientific trials, but until design and construction have attained some definite standard anything in the nature of a competition appears positively undesirable, since uniformity of tests or conditions cannot be obtained. Last year's report demonstrated that even machines of the same make could not be effectively compared and contrasted under the present trial regulations. The statistics showed that identical machines ploughed altogether different acreages per hour at different cost for fuel. From this fact it may be hazarded that if similar machines underwent a similar trial to-day a series of results would be obtained substantially different from those recorded last year.

Apart from these considerations, it must be emphasised that a test of a carefully tuned machine over a few days only, and in the hands of an expert operator, affords no criterion whatsoever of the reliability or the durability of the machine in farming practice; and if this is not demonstrated, any test is robbed of the greater part of its value.

To turn to a more technical point, it may be suggested that the method of classification by the formula adopted to measure horse-power is also open to criticism. This formula was based upon the declared revolutions, the piston area and stroke. Classification by such a formula is clearly open to improvement, as it is impossible to ensure that the competitor will actually run his engine at the revolutions declared. A competitor may, on this account, put identically the same machine in two different classes, the description of the machine being similar, with the exception of the revolutions. In practice this may not be serious, and it will afford makers a chance of putting their machines into the class most suitable for them. The whole question is admittedly difficult. Based on cylinder dimension, only the extreme high speed can give the best results, although, obviously, this is the least suitable

for practical work. A suggested alternative is to classify by weight, which would give a fair standard of comparison.

The decision of the Royal Agricultural Society to require the use of similar ploughs for identical tests has met with considerable criticism, not, it may be suggested, without substance. It is understood that the object was to discover which tractor did the greatest acreage on the least fuel with a given kind of plough. The implied premise is surely a false one. Power to plough two or more furrows, is no criterion of the capacity of a machine, for conditions vary with the same plough, even with the same setting—if that is possible to obtain, which is very doubtful.

There seems no practical reason why all kinds of ploughs should not be allowed. No tractor can be tested for efficiency in ploughing if it has not a plough suited to it. As foreign ploughs were excluded, some machines were handicapped; the best results could not be obtained with the ploughs supplied, and it is evident that the results are less valuable than they would have been if every machine had the option of using the plough to which it was best suited. Drawbar pull can be stated in definite figures, and the capacity of the tractor thus ascertained. It would be better if each machine were allowed its own particular plough and if a lengthy dynamometer test, giving definite figures, were adopted. The comparison would be placed on a scientific and easily calculable basis.

With regard to the actual ploughs used, it may be remarked that they were efficient, although, as compared with American types, on the heavy side. Considerable trouble was experienced with the " self-lift " device, but this appeared to be due to adjustment and not to weakness in design. The decision to insist upon uniformity of type had the advantage of bringing home to every spectator the need for further research in the design of ploughs. It was shown without question that a plough of the same design and setting will turn a very different furrow at different speeds.

The economical speed of mechanical traction is more than double that of the horse, and the mould boards which will need to be developed are those which will perform the work with greater speed and equal excellence. To the disappointment of many tractor manufacturers, and to the loss of agriculture, plough designers have not yet put upon the market implements which will take into account the requirements of mechanical traction. Undoubtedly a great deal of patient

scientific work is called for, and it will be necessary to examine the question whether the type of furrow at present favoured by farmers is essential.

A word may finally be said in reference to the commercial aspect of the trials, which it may be suggested is the sphere in which they will be of the greatest use. As compared with last year, the attendance and interest appeared to be markedly smaller, and it may be attributed, at least in large measure, to the decision not to have an exhibition of machinery in connection with the trials. The exhibition was undoubtedly a great attraction last year, and it does not seem unreasonable to suggest that agricultural machinery should be displayed for exhibition purpose where there are facilities for observing it at work as well as on the stand. In future trials it is to be hoped that this feature will reappear.

THE USE OF SOILING CROPS IN GENERAL FARMING.

Jas. C. Brown, P.A.S.I.,

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It is probable that the twentieth century will see great changes in the existing agricultural practice of this country. The early nineteenth century witnessed the perfection of the four-course system of farming, and during the later years of that century it was accepted, with local modifications, as the system best suited to the conditions of this country; indeed, tenants were often tied by agreement to make no changes. In many cases the British farmer was expected to accept the practice of his fathers without question, and to struggle against low prices as best he could. New ideas, however, prompted by scientific investigation and the changed economic conditions existing throughout the world, have of late years forced the farmer to review his methods. The four-course system was established during a period of cheap labour and high prices. With the increased cost of labour and shorter hours, the farmer will be obliged either to cut down his costs per acre, or increase his yield of produce. This problem faces all those connected with the farming of land with compelling insistence. The profits of the war period are passing, and with the high costs of production and the inevitable fall in prices profits are not likely to be as great in the immediate future.

That farmers are apprehensive of the future is shown by the increased tendency to put land under grass; yet it is of the greatest importance that, in the interests of maintaining the national food supplies, all suitable land should be kept under the plough and made to yield an economic return.

Of the two methods referred to by which farmers may meet the situation, viz. (1) either to increase the value of the produce per acre above the cost of production, or (2) to lower the cost of production while maintaining the yields at the existing level, the latter alternative is the more attractive. The immediate need is the application of new and less costly processes without reducing returns, so that the new arable land may not revert to the less productive grass.

There are many scientific reasons which can be given in favour of the four-course rotation ,but other methods of preparing land to receive a particular crop are known which are found to give quite satisfactory results. Cereals following grass are proverbially good, especially when the grass has been down for several years. Cereals also give good yields after fallow crops.

In this connection the results obtained on the Harper Adams Agricultural College Soiling Farm offer food for thought. Methods of cultivation have been tested which may have widespread application to English farming, especially in relation to economical production. One method has been established of preparing land for cereals by preceding the cereals with a soiling crop known as the Harper Adams Soiling Crop No. VI. This crop is a mixture of :—

Beans	1	bushel
Maple field peas	½	
Vetches	½	..
Clemrotheray or Duns oats... ...	2	..

This mixture cleans the land almost entirely of weeds, and pulverises the soil to a fineness which cannot be equalled by any form of mechanical cultivation. The ground is also fertilised as effectively as when farmyard or artificial manures are ordinarily employed. The effect of this crop on the succeeding one was clearly noticeable in the trials when the results were compared with those obtained from crops dressed with farmyard manure and preceded by rye without the leguminous plant.

The mixture gives the heaviest yields when sown in March or early April, but, in Shropshire, it has been found to give very heavy yields when sown as late as the 5th May; 20 tons per acre of green fodder can be obtained from this mixture on good land.

The possibility of growing this mixture as a grain crop suggests itself, but it is doubtful whether, in this case, the fertilising effect on the land would be equally good. There is little doubt that when a crop is allowed to ripen its seed, the land is left more impoverished than when the same crop is cut green. Fresh swede or mangold tops, when ploughed in, greatly enrich the soil for the succeeding corn crop, but little result is noticed if this green manure is allowed to decay on the surface. In the same way the unexhausted roots of the beans, peas and vetches, when the mixture is cut green, may have a greater manurial value than when the same plants are harvested ripe. The results obtained at the Harper Adams College suggest that, on heavy

clays, the bare fallow might be eliminated by growing Soiling Crop No. VI and wheat in alternate years. These crops would keep the land quite clean and in good condition without the need of any expenditure on manures, while the mechanical texture of the soil would be improved. The processes of cultivation, except ploughing and harrowing, would be performed by the crops themselves. If the crop were cut for green fodder, sowing wheat with the mixture in the spring to obviate the difficulty of autumn ploughing is worth consideration. Autumn wheat sown late in the spring stools only the first year, producing ears the second year. If the Soiling Crop No. VI is to be cut for seed this practice could not, of course, be adopted. The method is worth experiment, not only on clay land but on any land which is likely to go down to grass just at the time when wheat is urgently needed.

Soiling crops may also be grown to reinforce the pastures in early summer and in autumn, and also to produce part of the hay crop on arable land instead of obtaining the hay entirely from existing grassland. It is an established fact that average permanent grass is much more valuable for grazing than for mowing for hay, as its yield of hay is small and the quality of the produce is not always of the highest, while the land may be needed for pasturing. Instead of increasing the area of the farm under grass a much better practice would be to use the permanent grass to a greater extent for pasture, and to obtain the hay required from part of the new arable land. Heavy crops of pea and oat hay* of much superior quality to and of considerably higher yield than average meadow hay can be obtained from arable land. The crop also makes an excellent preparation for a cereal seed bed, as it leaves the soil clean and enriched.

In districts where the annual rainfall is less than about 35 inches, this method of keeping the arable land in cultivation is probably preferable to laying down new temporary pastures. In the drier districts temporary grass may fail to give a profitable return after the first year, while there is a risk that the pasture may fail to establish itself. In general, the period of high value of permanent grass is very short, and occurs between about the middle of May and the end of July. During these months the stock-carrying capacity of the land is relatively high, and if the land is stocked to its full capacity

* An account of this crop was published in this *Journal*, February, 1920, p. 1100.

at this period there will not be enough pasture for the animals when the grass begins to deteriorate in July, while if the farm is lightly stocked much inferior growth accumulates on the land. It is suggested that a great increase in the stock-carrying capacity of the country could be made by using the grass land to a greater extent for pasture, and devoting the excess of arable land to the cultivation of three of the soiling crops which have been found suitable at the Harper Adams Agricultural College. These crops may be fed to stock of all kinds on the grass land after the summer flush of grass is over. The three soiling crops referred to are:—

(1) Crop VII, a mixture of field peas 1 bushel, buckwheat 1 bushel, and rape 4 lb. per acre.
(2) Crop I, a mixture of giant rye and winter vetches.
(3) Crop VI (see p. 726).

Crop VII may be sown after Crop I, while Crop VI will be off the ground in time for the land to be sown with wheat or rye, for which it is an excellent preparation. A rotation of (1) Crop I, (2) Crop VII, (3) Wheat, (4) Crop VI, could be practised successfully, giving four crops in three years with one-third of the land under wheat. Crops I and VII could be used as green fodder, and Crop VI and the wheat crop allowed to ripen their seed.

Last year the experiment of planting a second crop on land which had carried a crop of pea and oat hay was tried. Several kinds of hardy kale were tested, Russian kale proving to be the best for the purpose. The kale plants were ploughed in every furrow early in August, and were not further cultivated; they rooted readily, and continued to grow until November, when growth ceased. The winter conditions were favourable, and the plants commenced to grow again about the beginning of February. In April flowering commenced, the crop being then about 4 feet high. The cows were pastured on the crop and consumed the succulent growth greedily. This plan of grazing off the crop, however, proved to be a mistake, as the land, being of a heavy nature, was badly "poached" by the treading of the animals, and difficulty was experienced in preparing it for the succeeding crop. On suitable soils, however, the practice might be worth adopting where the pea and oat hay mixture is grown. One drawback to the practice of growing green fodder crops for consumption on grass land is the cost of handling the produce, but this may be greatly reduced by using a mower, instead of the scythe, for cutting the crop, and employing a hay "bogey" with a low platform,

Showing Crop VII one month before the time for cutting. The mixture was sown on 13th June.

Showing Crop VI at the time of cutting. The mixture was sown on 6th May.
Neighbouring portions of the crop are shown side by side.

instead of a cart or wagon, for carrying the produce. It has been suggested to the writer that the operation of unloading in the field might be avoided if feeding racks carried on large wheels were constructed so that they could be filled with the green fodder and drawn to the grass field, and when emptied returned to the fodder crop to be refilled, the rack taking the place of the ordinary cart or wagon. The practice of tethering, so common on the Continent, does not seem suitable in this country, and the " poaching " of land in wet weather would undo much of the good brought about by the pulverising effect of the roots of the leguminous crops.

In conclusion, the writer would earnestly urge agriculturists to consider the suggestions here outlined. Peas, beans, and vetches are neglected crops to-day, although they figured prominently in British agriculture before the era of the turnip. They enrich the soil, and perform the work of the harrow and the cultivator. When mixed with cereals, they make a growth so dense as to destroy practically all weeds, and so make hoeing unnecessary.

We may perhaps hope that, just as in the eighteenth century the cultivation of the turnip increased the productiveness of the agriculture of this country, so may the general adoption of soiling crops on our farms mark the commencement of a new period of prosperity in the era which lies before us.

COTTAGE RESTORATION AND ADAPTATION.

MAXWELL AYRTON, F.R.I.B.A.

PRIOR to the War the repair and adaptation of old cottages to modern requirements for the accommodation of the land worker, for whom they were originally built, had practically ceased. Cottages and farm buildings were allowed to become derelict by the hundred, and only here and there a more thoughtful landlord called in expert advice to restore them to life. More often, however, such restoration was undertaken by enterprising townsmen for conversion to that creation of the last thirty years, the " week-end " cottage.

The reason for this apathy towards the improvement of old buildings is not far to seek. In the great majority of cases where labourers' cottages were wanted the work was entrusted to the estate agent, bailiff or local builder. In such circumstances it was undoubtedly cheaper to abandon the old cottages and build entirely afresh. A brick box, slate roof, imported doors and windows, and a blind eye for defects coverable by paint made it possible to satisfy the needs of the moment very cheaply in those days. The erection of new cottages also involved little trouble and less skill. The art of planning alterations and additions and the repair of existing buildings, on the other hand, is an exacting one, calling for hard brain work, experience, ingenuity and skill.

The architect, however, is rapidly coming into his own. The general public has realised the importance of his profession more in the last twelve months than in the same number of years before the War. Publications, exhibitions and the interest shown by the daily press have raised the standard of cottage planning and developed the public appreciation of good work.

It is difficult for those unacquainted with design in buildings to grasp the possibilities which lie in an old tumble-down building. To them the first solution of a problem appears the only one. How frequently dreadful botches of planning and impractical and uneconomical additions or alterations are excused on the ground that " this was the ' only possible ' way in which the work could be done ! "

It may be taken as a sound axiom that any old building which has been built on reasonably good constructive lines

lends itself to additions or alterations on at least as good lines as the original.

Such problems may be likened to a jig-saw puzzle, and should be entered upon in much the same spirit—that of certainty that, given the necessary patience and time, it *can* be solved—and that ideas must be as easily put aside as the pieces that do not fit, until the general lines are established, when the remainder will fall into place to make a complete and perfect whole.

The extremity in which the country finds itself through lack of housing has to be met by every means conceivable. The necessity for preserving every building fit for human habitation, if only temporarily, was obvious as soon as the acuteness of the present situation was realised, with the result that the work of restoration, addition, conversion and alteration is now being carried out on a much larger scale than ever before.

The importance of preserving existing houses becomes greater as each month passes, and the difficulties of the present scheme for housing become more apparent.

It cannot be urged too strongly that such work should be placed in the hands of sound architects. Without wishing in any way to detract from the capabilities of the estate agent, bailiff or builder, it must be clear that architecture is not part of their work, and they should not be expected to undertake duties obviously outside their own province.

The chief difficulty which has to be overcome in dealing with old cottages, and probably the one most frequently encountered, is dampness, and, in its worst form, rising damp due to the lack of a damp course! To cut out for and insert a damp course of slate or other impervious material is a laborious and consequently expensive operation, and also is unsatisfactory to the layman, who has nothing to show for the expense incurred, while the result can only be fully appreciated by the occupier. The man who pays perhaps naturally feels happier at the sight of a new roof, even though such an addition may not be necessary.

Much may be done, however, to remove dampness in walls by clearing away banks of earth, so often found round the sides of cottages above the ground-floor level, and by forming open brick or cement channels against the walls to carry surface water quickly away from the building. A cottage nestling deep in a group of trees, while very possibly picturesque, may

be much improved as a habitation by judicious felling, since trees hold the damp to an extraordinary extent.

Heavy creepers, on the other hand, should not be too readily condemned. Walls which, when overgrown with ivy, may be perfectly dry, are often found to be pervious to wet when stripped of their clothing.

In selecting a site for a cottage our forefathers had not the circumspection of to-day. Light, air and the natural benefits of the sun were not recognised; in fact it would appear that they were almost avoided, snugness, in a spot well protected from the force of the prevailing wind, usually being the principal consideration. In reconstructing a cottage it is sometimes advantageous to reverse the aspect so as to bring the sun into the "heart" of the house.

Much has been said about cottage planning in the last few years, but the variety of plans on which buildings may be constructed appears inexhaustible, and where one is limited by the existence of the "shell" of the house in which to plan a new interior, the problem becomes the more fascinating.

To get full accommodation and yet to keep within a strictly limited cubic capacity, in order to save in every detail of construction throughout, to provide the greatest comfort, to incur the least labour in upkeep, and at the same time to practise economy in every detail are matters which can only be handled in the light of experience.

In the actual carrying out of the work the country builder, if he is a good man (and he so often is), can be most valuable. It is a mistake often made to think that, because certain details have been drawn or specified nothing should therefore be allowed to alter them. The rural builder of the proper type is up to a thousand dodges and tips in matters of small construction and repair, not to be learned in architectural schools or offices. He will respect, and help you if you use him and his knowledge; but if he is treated merely as a means of carrying out to the exact letter what is shown upon the drawings, much good advice may be missed.

The Ministry is indebted to the Editor of "Country Life" for the loan of the illustrations which accompany this article. The illustrations are taken from "The Country Life Book of Cottages," by Sir Lawrence Weaver, who kindly permitted their use.

FIG. 1.—Lodge at Esher.

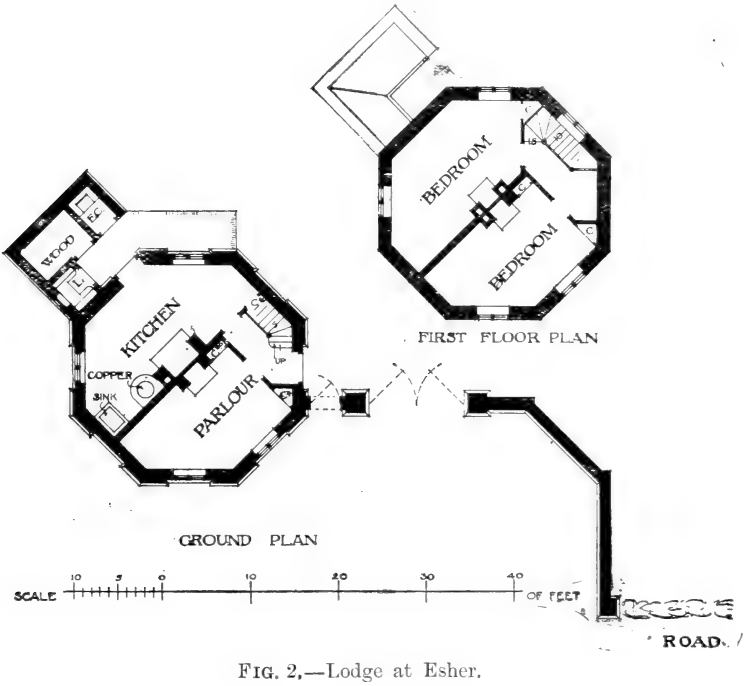

FIG. 2.—Lodge at Esher.

FIG. 3.—Octagonal Lodge at Moore Place, Esher.

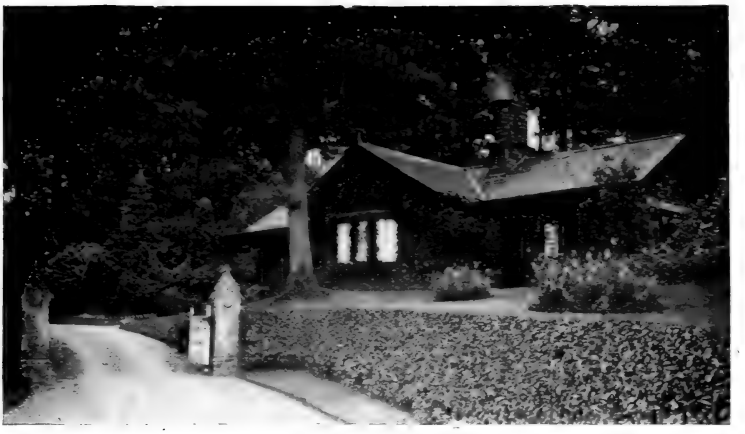

FIG. 4.—Lodge at Hole Hird, Windermere.

FIG. 5.—At Broad Campden, Glos.

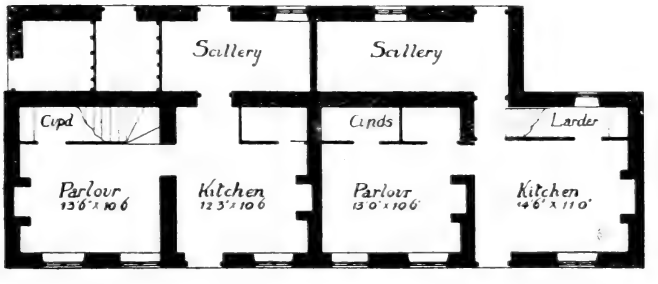

FIG. 6.—Four Roadside Cottages turned into Two and repaired at Broad Campden.

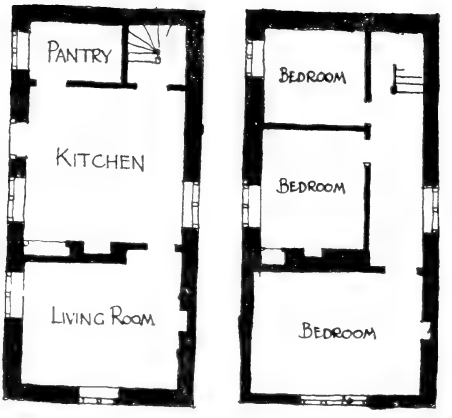

FIG. 7.—Ground and First Floor Plans of "Wests" as altered.

FIG. 8.—"Wests" Before Renovation.

FIG. 9. —"Wests" After Renovation.

FIG. 10.—"Jones's" Before Renovation.

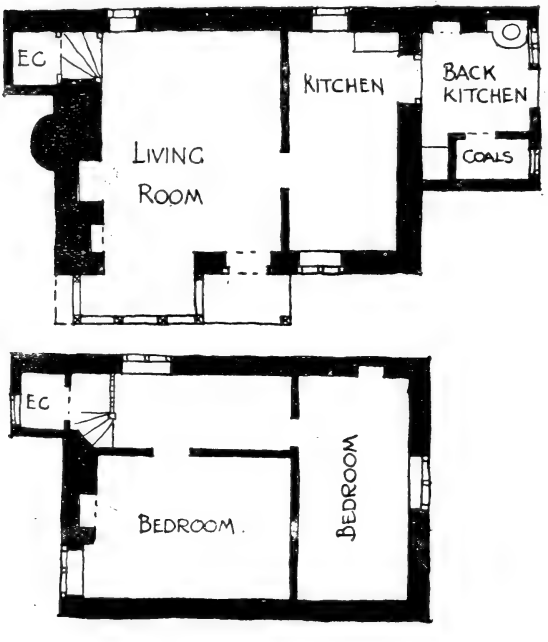

FIG. 11.—Plan of repaired Cottages called "Jones's."

FIG. 12.—"Jones's" After Renovation.

THE DISTRIBUTION OF WART DISEASE.*

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IN the early history of potato growing, limited cultivation had to a great extent kept the plant healthy, but when the natural and necessarily distributed culture was superseded by extensive field culture, the plant soon developed a tendency to diseases of various kinds. Owing to forced cultivation and unnatural propagation the plants were weakened, and their resistance to disease became less and less.

One reads of one disease after another attacking the crops until in the disastrous year of 1845 there occurred the great outbreak of potato disease ("Blight") in the British Isles. It was not until much later, however, that another and now considered serious disease of the potato, viz., Wart Disease, made its appearance to any great extent in this country.

Characteristics of Wart Disease.—It has been proved that Wart Disease of potatoes is caused by the fungus *Synchytrium endobioticum*. The characteristics of the disease are irregular warts or cauliflower-like protuberances, which grow from the eyes of the tubers and from buds on the rhizomes below ground. These warts may be less than a pea in size, or as large or larger than the tuber on which they grow.

Appearance of Plant.—A growing plant badly affected with Wart Disease generally shows no special features to distinguish it from other unaffected plants; though occasionally some of the lower leaves near the surface of the ground may be found to have developed into spongy-like, yellowish-green masses. These are modified leaves, and all stages are sometimes present, from a distorted warty lump, to a thickened spongy leaf, still bearing the unaltered leaf outline. On lifting a badly affected plant some or all of the tubers are found to have similar warty outgrowths, but the colour is yellowish, like the skin of the potato. In the case of potatoes growing near the surface of the soil, however, the wart may be pushed outside and develop chlorophyll, and so become greenish.

* Report of a paper read before the British Association for the Advancement of Science, at Cardiff, on 24th August, 1920.

The intensity of an attack of Wart Disease depends to some extent on the amount of water in the soil. In a dry season non-immune tubers are often found with few or no warts, even though the soil is known to be infected. The nature of the soil itself appears, however, to have little influence on the intensity of attack. All kinds of soil—sandy, clay, or medium loam—produce diseased plants, if the soil has become infected with the spores of the disease.

Origin of Disease.—The early history of Wart Disease is not known, and how the causal organism, *Synchytrium endobioticum*, came to attack the potato in this country has still to be discovered.

There is no evidence of the introduction of Wart Disease into the British Isles at any period, nor do we know if it is indigenous, living perhaps on fibrous or woody plants other than potatoes, without showing any outward sign of its presence in the form of a visible warty growth. The disease has never been found in nature on any plant other than the cultivated potato, and though in pot experiments it was found (by Mr. Cotton) on *Solanum Nigrum* and on *Solanum dulcamara*, its presence was not very marked, and might have been easily overlooked if these plants had been growing under natural conditions.

Another suggestion which may be put forward is that *S. endobioticum* (which belongs to a group of organisms of the lower fungi class, the spores of which are dispersed in the soil) may have existed in the earlier stages of its life history as a partial saprophyte, living on dead matter or plant residues and also on plant juices which had passed into the soil, and that in the course of time it may have gradually adapted itself to the potato, when certain highly susceptible varieties came into commerce.

This is, of course, only a matter of conjecture, but, if *S. endobioticum* is indigenous, and was present either on some wild plant without producing any deformation, which would call attention to it, or living in the soil, it is strange that the disease did not develop on the potato until after more than a century and a half of extensive cultivation, for field cultivation of the potato was general in England from 1728, and the earliest definite record of the presence of Wart Disease was made in 1898, though statements have been made by many that it existed for some considerable time before this date.

In support of the "indigenous" theory, therefore, we must assume that, if *S. endobioticum* was present at the time on other

host plants without being noticeable, or if it completed its life cycle in the soil as a soil organism without attacking any plant, the varieties of potato then cultivated must have possessed the characters of immunity from the disease—or that the fungus only acclimatised itself to live on these potatoes at a later date—but that, as these old resistant varieties were displaced by newer kinds, the fungus, finding in the newer varieties suitable hosts, gradually adapted itself to these and commenced a period of its life on the potato.

If, on the other hand, *S. endobioticum* is not indigenous, how was it introduced into this country? It is hardly possible that it could have been brought with the original potato from South America, as all the varieties from Chili which have been tested have been found to be immune, and in any case, if the disease had been introduced with the original potato, it is probable that the fungus would have made itself evident at a much earlier date, both in this country and in Germany, Spain, Austria and Belgium.

It is a matter of common belief in certain districts that Wart Disease was introduced into this country (with potatoes) from Germany, but there is little evidence in support of this statement. Wart Disease is present in Germany to a limited extent. It is found chiefly in West Germany (Rhine Provinces), and to some extent near Hamburg, and in Holstein. There are scattered cases elsewhere, but there is no evidence that it has been prevalent in the fields until recent years. All the available records go to prove that Wart Disease is more prevalent in the British Isles than elsewhere.

Early History of Disease.—Many gardeners and farmers in Lancashire and Cheshire have stated that Wart Disease was present in England in the 'seventies, and a number of people appear to have recognised it about that time.

It is not always wise to accept statements as to the presence of a disease many years before, unless the statements can be supported by facts. Wart Disease, however, is so characteristic, and is so different in appearance from other potato diseases, that more value than usual may be placed on the truth of these statements. If the statements are correct, it means that long before the scientific world knew of the existence of this disease, it had probably firmly established itself in cottage gardens in Lancashire, Cheshire and Shropshire, in North Wales, and in certain parts of the South of Scotland.

On very reliable authority the disease is said to have been present in potato crops in Haddington (Scotland) as far back as 1876.

One of the earliest reliable statements is that of Professor Newstead, who states that he remembers seeing it at Upwell, near Wisbech, in 1878; this is curious, since no disease has been discovered there since.

The first scientific record of the disease is that given by Schilbersky in 1896 (Hungary), but it has not been proved that it was actually present in Hungary at that time. A curious fact, however, is that one of the earliest definite records of the presence of the disease in potatoes in England is that published by Mr. Arthur Sutton (of Reading), who stated that his firm in 1898 received a specimen of potato affected in a peculiar way from the late Mr. W. Kerr of Dumfries. The specimen was stated to have come from Birkenhead, the variety being Imperator, grown from seed imported from Hungary. The disease was not recognised at that time, and was referred to by Mr. Sutton as "rust."

Mr. Nield, of the Holmes Chapel Agricultural College, Cheshire, first learnt of Wart Disease in 1895, and records that it was commonly believed in Cheshire that the disease was introduced by cattle boats arriving at Birkenhead.

Dr. MacDougall, in "The Transactions of the Highland and Agricultural Society of Scotland" (1903), writes that Wart Disease was first brought to his notice in 1899, among new seed potatoes sent from Cheshire.

The late Dr. Wilson, of St. Andrews, was the first to publish a record of the appearance of Wart Disease in Scotland. He states in his paper that a specimen was sent to him from Colinsburgh, Fife, in 1901, but, as previously stated, its existence in the Lothian districts of Scotland probably dates back to a much earlier period.

The disease was reported from Wales in 1901, and from Ireland in 1908.

From these scattered data we may safely conclude that Wart Disease has been present in this country for many years. The slow spread of the disease in these early days is a matter of some surprise, but it must be remembered that in the earlier stages of its history it spread locally, and when one takes into consideration the fact of a four years' rotation, it is easily understood how the disease would take some time to make itself evident to any extent.

It was not until 1907 that the serious nature of Wart Disease was generally realised by scientists. It became obvious at that time that it was increasing in intensity in infected districts, although growers were not inclined to believe that the disease would cause any commercial loss in the crop.

In 1908 an inquiry made by the Board of Agriculture into the nature and extent of the disease in England, Wales, and Scotland revealed that in certain areas, especially Lancashire, Cheshire, Staffordshire and South Scotland, the disease was extensive, and had been present for many years, and that certain varieties, viz., Conquest, Snowdrop, Golden Wonder, and Langworthy, appeared to resist the disease, although Up-to-Date growing alongside suffered severely.

Before dealing with the way in which this second discovery was made use of, it is necessary to pursue the history of the spread of the disease.

Spread in Recent Years.—In 1910, as in 1908, Wart Disease was chiefly confined to the counties of Lancashire, Cheshire, Staffordshire (and certain other counties in the Midlands), South Scotland, with a few cases in North and in South Wales, and isolated outbreaks in other parts, *e.g.*, Huntingdon, Cambridge, Middlesex, Berkshire, Cumberland and Yorkshire (West Riding).

Although, after a further period of three years, considerably more Wart Disease cases were known to exist in the country, the disease being more widespread in the old infected parts than hitherto, its actual spread to other parts of England was limited to a few outbreaks in counties which had hitherto been supposed free from disease, viz., Northumberland, Durham, and Westmorland in the North, and Somerset and Wiltshire in the South West.

By the end of 1916 Wart Disease had attained a firmer hold throughout the country and had spread in the former infected districts, especially in Wales and the West (the result it is said of planting seed from the infected districts of Lancashire). Outbreaks of the disease had also appeared in the extreme South, viz., in Dorset and Hampshire, and also in the South East (Kent), but generally the Eastern and Southern potato districts still remained clean.

A survey made at the end of 1919 shows that Wart Disease is now widely spread throughout the whole country, and that there is probably no county free from this disease. There is no doubt that the disease has made steady progress east-

wards at an alarming rate since 1916, several fresh cases having been notified from Lincolnshire and the East Riding of Yorkshire.

It had also spread in a south-easterly direction, outbreaks of importance having occurred in Surrey, the Home Counties and Kent.

Any explanation of the spread of infection must account for three essential facts:—

(1) The appearance of the disease as of economic importance from 1907 onwards.

(2) The greater concentration of the disease in the North and West, and the comparative freedom of the East and South.

(3) The relative suddenness of the spread of infection on the Eastern and Southern side since 1914.

The only possible explanation which will account for this geographical distribution of Wart Disease is that the main agent in the distribution of the disease is "seed"; although the variety of potato commonly grown at different periods may have determined the economic importance or otherwise of the disease.

(To be continued.)

PLANT BREEDING WORK AT ABERYSTWYTH.

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The first part of this article, published in last month's issue, contained a description of the Plant Breeding Station which has been formed at Aberystwyth for the purpose of improving and breeding strains of agricultural plants suitable for Welsh conditions. An account was given of investigations which have been conducted as necessary preliminaries to the actual breeding work with herbage plants. The writer pointed out that two methods are now being employed at Aberystwyth, namely, the collection of seed and the digging up of plants in toto *and planting them in gardens. As a first step the seed of indigenous grasses is being collected more or less in bulk from several different districts, in order to ascertain how indigenous seed (without special selection) compares with the ordinary commercial and imported stocks. Cocksfoot, tall oat grass, crested dog's tail, meadow foxtail and Timothy were in the first instance collected and sown, and perennial ryegrass, tall fescue and rough-stalked meadow grass have since been added to the species under preliminary investigation.*

INVESTIGATIONS relative to the improvement of grassland, conducted by the writer, have led him to formulate the following hypothesis as a guide to the selection of herbage plants. *First*, it is desirable that the plants should be late in flowering; even our native herbage plants flower and mature too early, with the result that the maximum grazing season is restricted. This evil has been well expressed by Brown,* who states, for

* Brown, Jas. C. "Dairy Farming on Arable Land."

example, that "grassland dairying is not a very perfect practice, owing to the rapid falling off in the milk-producing qualities of the grass after the month of June." For hay, early maturity is a great drawback, especially in districts where the hay is habitually cut too late. Gilchrist has advocated New Zealand cocksfoot on account of its later maturity. The value of meadow foxtail as a meadow grass, also, is much reduced by its particularly early maturity. *Secondly*, all the available evidence goes to show that a leafy herbage is more nutritious than is a stemmy herbage; it is only necessary to cite Hall's and Russell's work in this connection.* *Thirdly*, it would seem evident that the plan of selecting for maximum output of dry matter per acre as opposed to gross produce per acre would be applicable to grass improvement just as to roots. Thus the aim must be to produce grasses which flower and mature late and which yield the maximum of leafy (as opposed to stemmy) dry matter per acre per annum; and since the temporary ley of 4-6 years' duration is an important feature of grass land management in the West, the ideal grass must also be capable of uniform productivity over a 4-6 year period.

Up to the present experiments have been conducted more fully with cocksfoot than with any other grass. Twenty-four different lots, representing indigenous, Danish, American and French stocks were sown in small beds in the spring of 1919.† Each bed consisted of four rows 9 in. apart and 56 in. long. During the past spring and summer hay was cut from the rows on different dates, and the aftermaths cut at regular intervals. It is not necessary here to enter into details of the interesting results obtained, but reference to Table I, which gives the average gross produce from the beds of each nationality, and to Table II, which gives the gross produce of the best and worst lots, will reveal important facts.

* See *Jour. of Agric. Science*, Vol. IV. (4), June, 1912. It is obvious, of course, that "leafiness" is much influenced by habitat, but Hall's and Russell's data do not preclude the possibility of strains existing with a potentiality for leafiness.

† It was unfortunately not possible to obtain New Zealand seed for inclusion in these trials; seed from New Zealand has, however, been procured for subsequent sowing.

TABLE I.—A comparison of the total produce in hay and aftermath cuttings from cocksfoot nationality trials. The results given are the average produce per bed, each bed consisting of four rows 56 inches long. The average percentage of leaf in the hay (average of the four cuttings at different dates), and the average number of tillers per spaced plants of the same nationalities after ten weeks' growth, are also shown, together with notes as to the time of maturity of the several lots.

Nationality and No. of Beds averaged.	Weight of Hay in Oz.	Total Weight of Aftermath cuttings (green) in Oz.	Weight of Hay and Aftermath (green) in Oz. together.	Average Percentage of Leaf in Hay.	Average No. of Tillers per spaced Plant when 10 weeks old.	Remarks as to relative Dates of Maturity.
Indigenous (6) ...	50·04	55·04	105·08	37·65	18·2	8th June, 1920: no anthers exserted on 2 beds, but a few exserted on 3 beds, a few dehisced on one bed only. 19th July, 1920: practically no seed shed from any beds, 2 beds not dead ripe.
U.S.A. (6)... ...	52·00	43·80	95·80	24·60	16·1	8th June, 1920: anther dehiscence completed on 1 bed; on remaining beds slightly more than ½ completed. 19th July, 1920: seed dead ripe on all except 1 bed, much seed shed from the majority of beds.
Danish (10) ...	46·72	40·52	87·24	25·50	13·8	8th June, 1920: anther dehiscence completed on 1 bed, nearly completed on 4; about half completed on remainder. 19th July, 1920: all beds with seed dead ripe, most of seed shed from 2 beds and much shed on all beds.
French (2) ...	46·37	33·28	79·65	24·70	12·8	8th June, 1920: anthers on practically all panicles dehisced. 19th July, 1920: dead ripe and most of the seed shed.

TABLE II.—Showing the results given by the 9 (out of 24) lots of cocksfoot with a total yield of over 100 oz. per bed; the figures for the poorest sample of each nationality are also given.

Reference and Nationality.	Weight of Hay in Oz.	Total Weight of Aftermath cuttings (green) in Oz.	Weight of Hay and Aftermath cuttings (green) in Oz.	Average Percentage of Leaf in Hay.
		The nine best yields.		
Bc. 20 Indigenous ...	65·50	74·00	139·50	35·5
Bc. 21 Indigenous ...	60·00	55·70	115·70	26·8
Bc. 15 Danish	59·75	54·55	114·30	23·7
Bc. 17 U.S.A.	57·25	57·00	114·25	26·4
Bc. 13 Danish	61·75	52·50	114·25	31·0
Bc. 19 Danish	56·50	57·50	114·00	28·0
Bc. 16 U.S.A.	58·00	50·25	108·25	23·9
Bc. 24 Indigenous ...	51·50	52·50	104·00	46·8
Bc. 18 U.S.A.	52·00	51·50	103·50	23·6
		The poorest yields of each nationality.		
Bc. 2 Indigenous ...	35·50	47·50	83·00	43·00
Bc. 11 U.S.A.	40·00	33·00	73·00	21·90
Bc. 10 Danish	38·25	30·25	68·50	22·30
Bc. 4 French	38·25	28·75	67·00	23·90

It will be noticed that the indigenous plants were on the average very decidedly more leafy* than the foreign, and also appeared to possess the ability of greater tiller production. Of the twenty-four lots only one indigenous bed gave less than 30 per cent. leaf, and only one foreign (Bc. 13 Danish) gave over 30 per cent. leaf. Selected clumps put out in spaced rows showed similar results,† the foreign giving an average leafiness of 38 per cent. and the indigenous 49 per cent. Plate VIII shows the average difference in leafiness between an indigenous (Bc. 115) and commercial Danish (Bc. 75) clump.‡

In the matter of lateness, also, the advantage was entirely with the indigenous plants. This was confirmed by the behaviour of the selections, only one or two clumps being as

* The leaves were cut off from the stem at the ligule, so that, strictly speaking, "leaf" as here understood means the lamina only, and not lamina and sheath.

† Transplanting appears on all occasions to add to the relative leafiness of grasses.

‡ It cannot be asserted with certainty that the "plants" in each pot are definitely single plants, although when dug up from the beds in which they were sown and put out in "selection rows" they were thought to be so. They were only potted for the purpose of being photographed.

PLATE VIII.—Contrasting the leafiness of an indigenous Cocksfoot (=Bc. 115) with that of a foreign one (=Bc. 75=Danish).

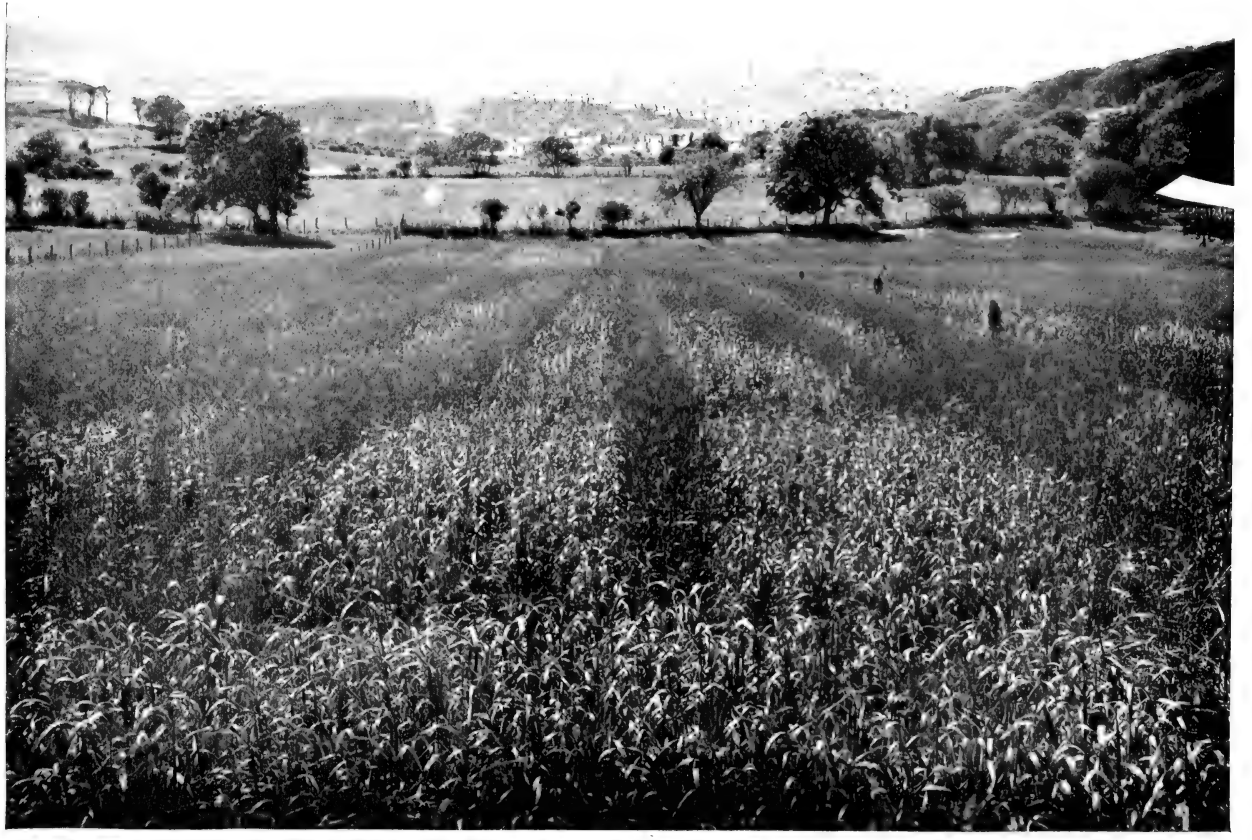

PLATE IX.—Showing the arrangement of the Oat Plots on the field. Note the dividing Rye Paths between the beds; the rye shows relatively dark in the photograph.

early as some of the later foreign selections, both the beds and the selections tending to show that the average order of maturity is:—France, Denmark, United States, indigenous. The gross produce from the indigenous, furthermore, averaged better than that from the foreign. The greatest gain, however, was in the aftermath cuttings, the samples from the United States giving a slightly higher hay figure than the indigenous. None the less, the heaviest hay yield was obtained from an indigenous plot.

These results are, of course, only to be regarded as tentative, but they have been referred to as showing the great difference that undoubtedly exists as between different lots of the same grass, and also in order to emphasise the fact that there is an undoubted potential usefulness in the selected seed of our indigenous herbage plants. The poorness of the French samples is striking, but it must be noted that these figures are based on the results of only two samples. The range of productivity of all the lots is a sufficient commentary on the need for devoting to herbage plants the same care as is given to cereals and roots, as even adjacent beds showed a disparity of over 18 per cent. Timothy and tall oat grass appeared to behave in a similar manner to cocksfoot, although the comparisons in the case of these two grasses have not yet been conducted on an extensive scale, and the two lots (only) of indigenous Timothy tried did not bulk as heavily as the commercial. It has not yet been possible to make numerous dry-weight estimations, and the degree of perenniality of the lots under investigation can only be arrived at after a lapse of a number of years.* The preliminary trials with crested dog's tail did not show such marked differences as those referred to above; indeed, the commercial lots have tended to bulk the heaviest, but the highest percentage of dry matter was obtained from an indigenous sample.

Meadow foxtail was not compared with commercial strains during the first year. The various indigenous lots, however, exhibited considerable differences in, *inter alia*, the matter of

* It would seem likely, however, that grasses grown from indigenous seed, like the seed of wild white clover, would prove to be longer-lived than plants from imported stocks. This would seem to have been so in the case of some of the ryegrass strains referred to by Peter Lawson and Son, and which were apparently so built up. Stapledon and Jenkin ("Pasture Problems," *Jour. of Agric. Science*, Vol. VIII. (1), September, 1916) have shown, moreover, that perennial ryegrass as an indigenous self-sown plant is usually much longer lived than are the plants derived from the sowing of commercial seed.

time of maturity, so that the selection of late strains may prove to be a possibility.

Data are naturally not yet available to indicate whether the generalisations that it has been possible to make between indigenous and commercial cocksfoot will apply equally when the plants are two or more years old, or whether "once-grown" commercial cocksfoot will behave in a manner more like indigenous. The preliminary work, however, would seem to suggest that, despite the undoubted influence of habitat on such characters as leafiness, time of maturity and tillering, it may nevertheless be possible to isolate strains with inheritable strong potentialities in the directions most desired. This season, as a natural outcome of the work, numerous selections have been made from local indigenous cocksfoot plants, and plants have also been obtained from several English counties. Endeavours will be made to ascertain the degree of stability of the various morphological characters of the plants by growing separated tillers of characteristic plants under different controlled conditions of habitat. In this connection it may be remarked that, although perennial wind-pollinated grasses present numerous difficulties to the breeder not experienced in the case of the annual and not readily naturally crossing cereals, the perennials at least have the advantage that one and the same plant can be divided into numerous tillers, and that groups of plants so produced can, if necessary, be moved from one habitat to another. Thus selections can be conducted under conditions of extreme rigour, while the actual plants selected can be brought to a more congenial habitat for the purposes of controlled pollination and seed production.

An important economic aspect of herbage work is the question of seed production. Experience must show whether reasonably good crops of clover and grass seeds can be grown and harvested with sufficient certainty under the climatic conditions prevailing in the College area. Small-scale garden trials have proved hopeful in this direction, and these have been followed up this season by the sowing of about five acres with the commoner grasses and clovers on the Danish plan with seed production lines (about 2 ft. apart).

Cereals.—In Wales oats must be regarded as the most important grain crop, and investigations with this cereal are therefore being started. Two distinct types of oats are required, the one for cultivation at high elevations near the

extreme limits of oat cultivation, and the other at lower elevations under general conditions of high rainfall.

At the higher altitudes *Avena strigosa*, known as "Ceirch Llwyd" or "Teify" Oat, is extensively grown, and the grain and straw obtained is chaffed together for horse feed; the usual practice is only to thresh enough grain for seed purposes. The local black oat, "Ceirch du Bach," is also grown under similar conditions in Cardiganshire and parts of Pembrokeshire, its place being taken in Radnorshire by the Radnorshire Sprig or Welsh Sprig Oat. Potato, Tartar, with the local black oats and some of the newer varieties, especially Abundance, are grown at the lower elevations. Early maturity and an ability to stand are essentials in an oat grown under the conditions prevailing, while a straw of good feeding value is also necessary, since the great majority of the oats grown, at all events in West and Central Wales, are for consumption on the farm. Preliminary work is being undertaken in three directions: first, a critical study and analysis of the local or "land" oats; secondly, a systematic study of oat varieties in general; and thirdly, yield trials with the varieties in commoner use in comparison with the local oats. It has been found, for instance, that samples of Ceirch du Bach, in addition to containing the grain of other varieties (chiefly the Teify Oat and Potato) also give rise to several forms which are to be regarded as different types of this "land" oat. It is probable that five forms will be isolated from the current plots. The most interesting is perhaps a grey grained type similar in other respects to the commonest black type, and which appears to breed true to greyness.

It cannot yet be said whether the grey and other forms that have been identified will prove to be of economic significance; these are, of course, being isolated with a view to the possibility of ultimately working up pure lines from those forms which preliminary mass selection proves to be of the greatest value.

The most important aspect of this season's work has been the critical study of varieties. This has been undertaken with two ends in view: (1) to prepare a key to the identification of oat varieties, and (2) to contrast and study the earliness or the reverse and other agricultural properties of the varieties, with the ultimate object of making judicious selections of parents for hybridization.

It has been the endeavour at the Station to grow as many

varieties as possible, and as a result of valuable help given from numerous sources, as many as 154 varieties have been included in these trials.* In order to test the purity and trueness to type of the varieties as obtainable on the market, several " lots " of all the more important varieties have been grown. The oats were sown in the field in thin drills 20 ft. long and 14 in. apart, all the beds being divided by rye paths. This trial was set up in the middle of about a 3-acre breadth allocated to oat experiments, and the rye paths made the whole a homogeneous cereal field. The effects of edges were thus obviated and damage from birds lessened.† As an additional safeguard a small patch of each variety was sown in the cage, but this has proved not to have been necessary, for the " take " in the field has been excellent, and birds have not proved unduly troublesome.

This is not the place to anticipate the results that have been derived from the work. The systematic study of oat varieties is being undertaken by Mr. C. V. B. Marquand, who has approached the problem not only from the point of view of the systematist, but also with regard to the agricultural potentialities of the several varieties. It is hoped to publish a full report of the work in due course.

It is interesting to remark, however, that the cultivated varieties of *Avena sterilis* have proved to be considerably earlier than the *A. sativa* varieties grown in this country. Thus, the Algerian oat sown on 8th December came into ear 21 days earlier than both winter and spring varieties sown on 6th November. Burt, Red Rust Proof and the Algerian oat sown with the other varieties in drills in the field on 22nd March were the first to come into ear and ripen, being at least six days earlier than any of the *A. sativa* varieties normally grown in this country.

The yield trials were conducted on the small plot plan. Rod plots sown at the rate of 3,000,000 grains per acre have been employed, with rye-dividing paths. About 40 varieties, involving 150 rod plots, have been tested this season. The *American*

* Thanks are due in particular to Dr. Taylor, Chief of the Bureau of Plant Industry, Washington; Professor Zavitz, of the Agricultural College, Ontario; Dr. Dorph Petersen, of Copenhagen; Dr. Trabut, of Algiers; to Messrs. Vilmorin, of Paris, and Messrs. Haage Schmidt, of Erfurt, for help in the collection of foreign samples; to Dr. W. G. Smith, Mr. T. Anderson, Mr. C. B. Saunders, Professor White, and Mr. G. Miln, of Gartons, Warrington; and to the following seedsmen :—Messrs. Temperley, Dunn, Toogood, Webb and Carter, for assistance in the collection of both foreign and British samples.

† The cereal path plan is largely adopted at Svalöf, and the experience of the present season has proved it to be an excellent procedure.

*Sixty Day** came into ear 12 days earlier than any other variety.† It did not actually ripen, however, any sooner than *Dala* or *Yielder*, but shared first place about equally with these.‡ The Irish Tan oat§ has evoked favourable comment from hill farmers; it is very decidedly earlier than *Ceirch du Bach*, and would seem to produce an abundance of straw, and it may well be worth consideration for our hilly districts. Of "grain producers" but slightly or never grown in the district *Victory*, *Crown*, *Banner* and the Danish Oat, *Gul Naesgaards*, have the appearance of yielding heavy crops.‖

It has been noticed that the potato and closely related varieties have been attacked by both smut and rust to a greater extent than any other group of allied varieties.

Yield trials will be conducted on a greatly reduced number of varieties next spring, and will be followed up for several years; the duplicated small plot will form the basis of all the trials. One object of the trials set up during the present season has been to experiment with the management and technique of small plots, as it is intended to conduct all trials at Headquarters on this plan.

The general arrangement of the cereal plots is shown in Plate IX. It may be remarked that the sowing of these numerous small plots did not prove to be such a serious undertaking as was anticipated. All the beds and plots were measured out some time before sowing commenced, and the drills for the oat rows were drawn from three weeks to a fortnight before the grain was sown. About three-quarters of the 1,080 rows were actually sown in one long day by a party consisting of four of the scientific staff and five of the garden staff. The paths were largely sown during adverse weather conditions.

The preliminary work on oats has shown that in normal circumstances the average hybridization season will be a very short one at Aberystwyth. The effective flowering period will

* The seed of this variety was obtained direct from America by the Ministry of Agriculture, which was able to place a portion of the grain at the disposal of the Station.

† It was not possible to procure a sufficiency of seed of any *A. sterilis* variety for inclusion in the rod plot yield trials.

‡ The slow ripening was doubtless in part due to wet weather, of which these early exserted panicles had a longer period than the later produced panicles of *Dala* and *Yielder*.

§ This oat was included in the trials on the advice of Mr. P. G. Dallinger, of the Ministry of Agriculture, and samples were obtained through the kindness of Mr. Pimlott, of the Irish Department.

‖ A full report of the yield trials will be published as a College Bulletin early next year. The plots will be threshed on the field. Practically all of the plots have been cut at the time of writing this article (September 14th).

consequently have to be lengthened by every means possible. Three plans are under experiment, viz., (1) resort to glass; (2) sowing spring varieties in a sheltered cage in the autumn; and (3) starting the seed in boxes in gentle heat or in cool frames and planting out. A certain proportion of all the spring varieties sown in the garden last autumn came well through the winter, and flowered very appreciably earlier than the spring-sown plants; those sown in boxes did not transplant particularly well, but with greater experience this method may prove of assistance.

In conclusion a word may be said as to the general arrangement of the gardens. These are three in number, and are used for more or less definite purposes.

The Nurseries.—This is the headquarters garden, and contains the large cage and box culture trenches and also the glass houses, stores, potting shed and a small field laboratory. It is used chiefly for the collection of indigenous plants dug up *in toto*, for the first growing of collected seeds, and for grouping selections.

The Terraces.—This is used for small scale nationality and place-of-origin trials and for the first multiplication of selected plants.

The Triangle, which is more sheltered than the other gardens, is intended primarily for hybridization work, for all investigations bearing upon the fertility affinities of the grasses and clovers, and for experiments generally as opposed to pedigree cultures. This garden is also equipped with a small cage.

It is hoped to bring the farmers of the adjoining counties into the closest possible touch with the work of the Station. During the present season, despite the difficulties connected with the harvest, two parties have visited the trial grounds from Montgomeryshire, a large party from Cardiganshire, and a small party from Pembrokeshire, and it may be taken as a hopeful augury for the future that as much interest was shown in the small-scale—from the farmers' point of view one might almost think ridiculously small-scale—trials conducted in the gardens as in the oat variety and other larger and more obvious experiments in the field.

LICENSING OF STALLIONS UNDER THE HORSE BREEDING ACT, 1918; SEASON 1920.

As part of its operations for the improvement of the horse-breeding industry the Ministry introduced in 1911 a scheme for the voluntary registration of stallions with a view to the gradual elimination of unsound stallions in England and Wales. Owners of "Pedigree" sires were invited to submit their stallions for examination by veterinary surgeons appointed by the Ministry, and certificates of soundness for breeding purposes were issued in respect of those stallions that passed the examination. In the year 1911, 313 certificates were issued, and the number increased each year until 1919, the last year of voluntary registration, when 2,334 certificates were granted. The steady increase in the number of stallions registered each year indicated clearly that owners recognised the advantage of having the Ministry's certificates of soundness for their stallions.

With the support of the Horse Breeding Societies, and with a view to protect the owners of registered stallions from the unfair competition of unsound animals, and to give mare owners a larger number of sound sires from which to select, it was decided to go a step further and to require by statute the compulsory licensing or certification of all travelling stallions, pedigree and non-pedigree. The necessary legislation, the Horse Breeding Act, was passed in 1918. Under this Act, and the Horse Breeding (England and Wales) Regulation, 1919, it is illegal for a stallion of two years of age or over to be travelled after 1st January, 1920, for service, or exhibited on premises not in the occupation of the owner of the stallion with a view to its use for service, unless the stallion is at the time licensed under the Act.

It may be of interest to those who are endeavouring to secure improvement in the horse-breeding industry by the elimination of unsound travelling stallions and by other means, to know the results of the first year of operation of the Horse Breeding Act. Up to the close of the past season, 4,153 stallions were examined, and of these 3,749 were licensed by the Ministry. The remainder (404) were refused licences. Of the 3,749 which were licensed, 3,370 were pedigree stallions and 379 were horses not entered or accepted for entry in any recognised Stud

Book. As evidence of the popularity of the Shire it will be seen from the following table that of the 3,370 licensed pedigree stallions no fewer than 2,258 were of that breed, and that 172 of the 379 licensed non-pedigree animals were also of that type.

TABLE I.

	Heavy.				Light.										Pony.									
	Breeds.				Breeds.										Breeds.									
Pedigree Stallions, *i.e.*, Stallions entered or accepted for entry in the recognised Stud Book of their Breed.	Shire.	Clydesdale.	Suffolk.	Percheron.	—	Hackney.	Thoroughbred.	Arab.	Hunter.	Cleveland Bay.	Yorkshire Coach.	Welsh Roadster.	—	Welsh.	Polo.	Dales.	Fell.	Shetland.	Highland.	New Forest.	Welsh Cob.	—	Totals.
Licensed	2,258	286	193	33	—	202	183	19	9	8	7	3	—	33	21	17	17	10	1	1	69	—	3,370
Refused	262	46	12	1	—	17	10	—	1	—	—	—	—	—	1	—	2	1	—	—	6	—	359
Applications	2,520	332	205	34	—	219	193	19	10	8	7	3	—	33	22	17	19	11	1	1	75	—	3,729

	Types.														Types.									
Non-Pedigree Stallions, *i.e.*, Stallions not entered or accepted for entry in a recognised Stud Book.	Shire.	Clydesdale.	Suffolk.	Percheron.	Others.	Hackney.	Thoroughbred.	Arab.	Hunter.	Cleveland Bay.	Yorkshire Coach.	Welsh Roadster.	Others.	Welsh.	Polo.	Dales.	Fell.	Shetland.	Highland.	New Forest.	Welsh Cob.	Others.	Totals.
Licensed	172	10	4	9	54	41	2	1	5	--	1	4	30	1	-	3	2	—	—	—	20	21	379
Refused	23	5	—	—	7	3	—	—	—	—	—	—	4	—	—	—	—	—	—	—	1	1	45
Applications	195	15	4	9	61	44	2	1	5	—	—	4	34	2	—	3	2	—	—	—	21	22	424
Total Licensed	2,430	296	197	42	54	243	185	20	14	8	7	7	30	34	21	20	19	10	1	1	89	21	3,749
Total Refused	285	51	12	1	7	20	10	—	1	—	—	—	4	1	1	—	2	1	—	—	7	1	404
Total Applications	2,715	347	209	43	61	263	195	20	15	8	7	7	34	35	22	20	21	11	1	1	96	22	4,153

The following diseases or defects are prescribed in the Regulations as rendering a stallion unsuitable for service of

mares, namely: cataract, roaring, whistling, ringbone (high or low), sidebone, bone spavin, navicular disease, shivering, stringhalt and defective genital organs.

The table hereunder gives the number of horses in respect of which licences were refused, and the diseases on account of which they were refused:—

TABLE II.

BREEDS.	No. examined.	No. refused.	Percentage of refusal.	REASONS FOR REFUSAL.											
				Roaring.	Whistling.	Sidebone.	Cataract.	Ringbone.	Bone Spavin.	Defective Genital Organs.	Stringhalt.	Shivering.	Defective Conformation.	General unsuitability.	Navicular Disease.
Pedigree.															
Shire	2,520	262	10·4	74	73	57	19	14	4	10	2	5	1	3	..
Clydesdale	332	46	13·8	14	10	13	1	3	1	3	1	..	..	..	..
Suffolk	205	12	5·9	..	8	2	..	..	1	1	..	..	..	..	..
Percheron	34	1	0·3	..	..	1	..	..	..	..	..	..	..	..	..
Hackney	219	17	7·8	3	1	3	2	1	2	1	3	..	1	..	..
Thoroughbred ..	193	10	5·2	..	3	..	..	2	3	1	..	..	..	..	1
Hunter	10	1	10·0	..	..	..	..	..	1	..	..	..	..	..	..
Polo Pony	22	1	4·5	..	..	..	..	..	1	..	..	..	..	..	..
Fell Pony	19	2	10·5	..	..	1	..	..	1	..	..	..	..	..	..
Shetland Pony ..	11	1	9·1	..	..	..	1	..	..	..	..	..	..	..	..
Welsh Cob	75	6	8·0	..	1	3	..	..	1	..	1	..	..	..	..
Non-Pedigree.															
Heavy	284	35	12·3	9	5	12	..	1	2	1	1	2	2	..	..
Light	90	7	7·8	2	..	1	1	1	1	1	..	..	..	.	..
Pony and Cob ..	50	3	6·0	..	..	1	..	..	2	..	..	..	..	..	..
Totals of defusals ..	..	404	..	102	101	94	24	22	20	18	8	7	4	3	1

Seventy-seven appeals were made against refusals of licences, and in 27 cases these were successful. The 27 cases are not included in the table.

Attention is drawn to the fact that persons who are in charge of stallions travelling for service are liable to be called upon to produce their licences, and in this connection the provisions of Section 3 (Sub-section 3) of the Act cannot be too widely known. Under that Sub-section a licence granted under the Act or certified copy thereof shall be produced :—

(*a*) at the time of or before the service by the stallion of a mare, if so required by the owner or person in charge of the mare ; and

(*b*) at any time, if so required by an officer of the Ministry or a police officer or any person authorised by regulation under this Act ;

and if the person for the time being in charge of or having control of the stallion fails to produce the licence or certified copy when so required he and also the owner of the stallion, if the failure is due to his default, shall be liable on summary conviction to a fine not exceeding £5. The Ministry this year instructed their Inspectors to require the production

of licences for stallions they met on the road and also invited the co-operation of the police in this direction. The necessity for having the licence available for production by the groom did not seem to be generally understood at first, but fewer contraventions in this respect were reported towards the close of the travelling season, and it is hoped that next year owners will not fail to send out the licences with the stallions. The policy of the Ministry this year—the first of the operation of the Horse Breeding Act—has been to warn stallion owners and others of the requirements of the Act, and prosecutions have only been instituted in those cases where deliberate contraventions of the Act have occurred.

It should be added that licences issued for the licensing year 1920 expired on the 31st October, 1920, and should be returned to the Ministry as soon as possible after that date. Failure to comply with this requirement renders an owner liable to a fine not exceeding £5. From the 1st November, 1920, applications may be made for licences for the year ending 31st October, 1921, and as the Ministry cannot undertake to examine stallions at short notice, owners are advised to send in their applications at the earliest possible date. If many defer doing so till the service season approaches it will not be possible to deal with all applications before the season actually commences.

EDUCATION IN POULTRY KEEPING.

PERCY A. FRANCIS,

Technical Head of the Small Live-Stock Branch, Ministry of Agriculture and Fisheries.

THE chief objects of education in poultry keeping are to improve generally the methods practised by persons engaged in the poultry industry, so as to enable them to obtain the best possible financial results from their efforts and to compete successfully with foreign producers.

It is obvious, therefore, that education in poultry keeping must be, as a rule, directly vocational in character, though the importance of developing the student's powers of observation and clear thinking should be borne in mind. Persons who have received a good general education before studying the special problems involved in poultry keeping are undoubtedly in a favourable position to assimilate readily vocational instruction, and can bring to bear trained powers of observation and deduction upon the methods adopted in an industry which is new to them.

In other words, a trained and cultivated mind has always an advantage over the untrained, given equal natural ability at the outset, and thus the possession of a good general education is always of great value to students of poultry keeping, and enables them to attack more easily the various practical, commercial, and scientific problems which arise from time to time in connection with their work.

It is no doubt true that skill in controlling labour, shrewdness in buying and selling, soundness and quickness of judgment on the various points of difficulty—met with in poultry keeping as in every other industry—are, to a large extent, inherent in the characters of successful poultry farmers, or are only acquired as a result of long and sometimes expensive experience. At the same time technical instruction is obviously of great value to the beginner, and is also the means by which the more experienced poultry keepers are kept informed of the results of the work and investigations of others.

Need of Education in Poultry Keeping.—It is well known to those of us who have worked for many years as itinerant poultry instructors how often poultry keepers, living a comparatively short distance apart, know little or nothing of each other's methods, though of recent years the work of poultry

societies, itinerant instructors, and the poultry press has done much to promote interchange of ideas and experience. There is still, however, a wide field for the dissemination of knowledge. How few farmers, for example, have ever seriously studied the lessons to be drawn from the numerous laying trials conducted for many years past in this and in other countries! How many poultry keepers still use and erect poultry houses of uneconomic types and pursue methods of breeding, feeding, and general management which, in the light of up-to-date knowledge, are known to be inefficient!

These are some of the causes which compelled Great Britain last year to pay approximately £35,000,000 to other countries for eggs and poultry, though we know there are, in this country, large quantities of waste food from households, and natural poultry foods on wide areas of land, which could be profitably converted into poultry products if poultry were more generally kept, and kept on efficient methods.

It may be true that we have in this country breeders of poultry whose skill is not excelled in any other part of the world, but it is equally true that the methods practised by many of our poultry keepers leave much to be desired. There are also many beginners every year, probably more this year than ever before, and the continued and extended dissemination of technical knowledge is essential to successful progress.

Poultry Clubs and Societies.—For many years the poultry clubs and societies have been doing valuable work in this direction, but their activities have been limited to some extent by the funds at their disposal. Much of their work, however, is of a voluntary nature, and the industry owes a debt of gratitude to the men and women who have given so freely of their time and energy to this work.

State Assistance.—State-aided poultry instruction has also been provided for many years in this country, partly in direct form, but mainly through local authorities and educational institutions. The majority of the county councils in England and Wales now employ whole or part-time poultry instructors of either sex, the expenditure involved being met usually from a joint fund made up as to one-third from the local rates and as to two-thirds by a grant from the Ministry of Agriculture.

In a number of counties the instructor acts as both dairy and poultry instructor, though this combination of duties is not desirable, since pressure of seasonal work in both is to a large extent simultaneous, and one or both branches are liable

to suffer. The financial economy derived from such an arrangement is, therefore, of doubtful value, especially in view of the urgent need of building up the British poultry industry before foreign competitors produce again exportable surpiusses to the same extent as in pre-war days.

At the present time there are 57 whole or part-time itinerant poultry instructors employed in England and Wales. In a few counties it has been found necessary to appoint assistant poultry instructors, as, for example, in Yorkshire, where there is an increasing demand for instruction from industrial areas. There are, however, eight counties which employ no poultry instructor, *i.e.*, Bedfordshire, Cambridgeshire, Isle of Ely, Huntingdon, Isle of Wight, Norfolk, Somersetshire, and Soke of Peterborough.

Owing to the extension of poultry keeping in industrial areas and the increasing demand for instruction manifested in some of the county boroughs, the Hull County Borough Council have informed the Ministry that they desire to set up a scheme for the provision of instruction in poultry keeping which would include the provision of an egg-distributing centre, and have inquired whether a grant could be made as in the case of county education authorities. This is the first case of a county borough desiring to inaugurate a scheme apart from the county scheme. Owing to the size of the population and the large number of allotments, the borough council consider there is sufficient work for a whole-time poultry instructor.

In addition to provision made for itinerant instruction by county councils, poultry instructors are also employed by some 20 or more agricultural colleges, farm institutes, and farm schools, most of which receive grants from the Ministry for their general agricultural work, including instruction in poultry keeping. In several instances these institutional instructors also do a certain amount of itinerant work in the adjoining counties.

Importance of Co-ordination and Co-operation.— It is desirable that in future these various educational activities should be more closely co-ordinated and organised on more efficient lines, and that there should be more effective co-operation between local authorities and the local poultry societies and clubs. This co-operation ought not to be difficult of achievement if the societies would show active interest in the work of their county councils and educational institutions, and would endeavour to obtain representation on the committee of the

council which is charged with the supervision of the county poultry schemes.

There is no reason why representation for local poultry keepers' interests should not be obtained in this way, and societies and clubs would then have a direct voice in the administration of county council poultry schemes, and much more efficient co-operation between State-aided and voluntary effort would be possible. In too many instances in the past the county poultry instructor has been doing isolated and comparatively unknown work with little public support. Let the societies and clubs see that this is changed; that the county councils, colleges, and their instructors are given the fullest measure of support and assistance, and that thereby the greatest possible efficiency is obtained in carrying out the schemes for which only a very limited amount of public money is available.

The societies and clubs can help in so many ways—by suggesting centres for lectures, classes, and the establishment of egg-and-chick-distributing centres; by keeping their members informed as to lectures, &c., and the dates when the county instructor is expected to visit the various districts; by distributing leaflets and bulletins; and by generally assisting the instructor to perform his many duties efficiently and without undue delay.

Various Needs to be Met.—The problem of providing suitable forms of education in poultry keeping to meet the needs of all is not an easy one. There are those who cannot spare more time from their work than is occupied in attending an occasional public lecture, and persons of this type may be country, urban, or city dwellers. There are the sons and daughters of farmers and small holders who will be occupied ultimately, as a rule, in poultry keeping as a branch of agriculture or horticulture. Others may desire instruction to enable them to make poultry keeping their main source of livelihood; and, finally, there are those who desire a complete scientific and practical training to equip them as qualified teachers of poultry keeping.

Itinerant Instruction.—For the mass of poultry keepers all the evidence available in this and other countries goes to show that itinerant instruction by competent instructors is by far the most effective form of education. This includes lectures, visits to poultry keepers in their homes, and peripatetic classes.

Public lectures usually constitute the preliminary stages of itinerant instruction, and though the actual teaching value of these lectures is necessarily somewhat circumscribed, they serve to arouse interest, and have been the means of creating large numbers of new poultry keepers, and assisting many others. Visits by the instructor, if properly carried out, probably constitute the most effective method of conveying information to those who are the producers at the moment and who do not, for various reasons, attend lectures or classes, nor, to any extent, read poultry papers.

When the itinerant instructor has gained the confidence and respect of these people, he can be of help to them in many ways. He is able to advise them on the spot in a manner suitable to their particular circumstances and aims. He can give help not only in purely technical matters—and in a young industry, where improved methods are frequently being evolved, it is important that knowledge of these should be spread as quickly and widely as possible—but he can often give valuable advice as to marketing produce and purchasing feeding stuffs, appliances, &c. It is astonishing how often poultry keepers buy their requirements in the dearest markets and sell their produce in the cheapest.

Itinerant lectures and visits are still the basis of instruction in most counties, but in order to meet the increasing demand for more systematic instruction a few counties have commenced peripatetic classes for younger people who can only leave their homes or employment for a few hours daily. These classes, which are held for short periods of three or four weeks at various centres, provide not only theoretical teaching, but also practical instruction in artificial and natural methods of hatching and rearing; testing, grading and packing poultry produce; killing, plucking and trussing poultry; construction of simple appliances, &c. The courses are usually held daily at hours suitable to the seasonal work of the district, and at the end of the course the equipment is moved to a fresh centre, so that the instruction is conveyed, in time, over the whole county. Thus, in Shropshire, for the year ended 31st March last, the poultry instructress, in addition to her other duties, conducted six four-week courses at various centres, at which an average of eight pupils attended right through. It is obvious that if those pupils, as is probable, put into practice at home the information gained at the classes, they will not only benefit themselves, but they will also

exercise a good influence over other poultry keepers who may live near them.

Schools of Instruction.—Then, as distinct from itinerant instruction, regular courses are provided at the farm institutes and farm schools, which have been set up in some counties and are under consideration for many others. A number of these will be in operation during the next 18 months. At these institutes or farm schools, which are intended to provide instruction on a lower plane than that of an agricultural college, young men and women of 16 and upwards are instructed in the various subjects of rural economy, including poultry keeping. Poultry stock and plant on modern lines usually form part of the educational equipment, and regular instruction is provided. Students take part in the routine practical work, and thus become familiar with the various appliances in use, and with the points and economic qualities of the breeds maintained. Thus, at the Farm School, Newton Rigg, Cumberland, 64 pupils received general instruction in poultry keeping last year.

Higher Education at Colleges.—Finally, the provincial agricultural colleges, in addition to providing instruction in poultry keeping to their agricultural and dairying students, provide also, in some cases, special courses in poultry keeping for students who desire to obtain a more specialised knowledge of the subject, *e.g.*, the Harper-Adams College provides special courses extending over one session of three terms. These courses include instruction in anatomy, physiology, and diseases of poultry, natural and artificial incubation and brooding, foods, feeding, and general management, parasites, and the various enemies of poultry, water-fowl, and turkeys, book-keeping and carpentry. Lectures are also provided on elementary agriculture and on the economic relationship between poultry keeping on the one hand and agriculture, horticulture, and market gardening on the other. Practical work is provided for the students on the college poultry plant. Demonstrations are given in connection with the college laying trials, and visits are paid to well-managed poultry farms within easy reach of the college.

Possibilities of Extension of Poultry Education.—From the foregoing it will be gathered that considerable provision for instruction in poultry keeping is already made in this country, and there is no doubt as to the beneficial effect which has

accrued from this work. There is, however, considerable room for further extension, especially as regards higher instruction for those who desire to become teachers of poultry keeping. This is an age of specialisation, and when regard is had to the amount of educational, investigational, and research work carried on in connection with the poultry keeping industry in America it is obvious, particularly in regard to investigation and research, that much more requires to be done in this country if home production is to be substantially increased and future foreign competition successfully met.

Unlike agriculture, the poultry industry, regarded as a commercial venture, is of comparatively recent growth. Methods are far from being perfected or standardised, and the comparative values of different practices in feeding, housing, and general management require investigation. Our knowledge as to the best methods of combining poultry keeping with either horticulture, market gardening, or agriculture, is still limited. The efficiency of present methods of artificial hatching and rearing leaves much to be desired; whilst our knowledge of poultry diseases and their prevention is still very imperfect.

The poultry institute, which it is hoped may be established before long, will have a wide sphere of work, much of which will be on virgin soil so far as this country is concerned, and should prove of immense value to all poultry keepers. The poultry industry means more to this country than many people imagine. No definite figures are available as to the quantity or value of the poultry and eggs produced annually in Great Britain, but it is practically certain that poultry produce to the value of well over 50 millions sterling was consumed in this country last year, though, unfortunately, Great Britain paid 35 millions of this sum to other countries.

When it is remembered that poultry keeping offers a profitable spare time occupation to many classes of people, that poultry can be kept in a large degree as an added crop on the land, and that under proper management they can be fed to a considerable extent on waste materials and by-products, it will be realised that the possibilities of expanding home production are very great. There is also no doubt that home-produced poultry and eggs are infinitely better for the health of the nation than imported frozen poultry, and preserved dried or liquid eggs from China.

PROFITABLE PEARS FOR MARKET.

In successful pear-growing, great care is required in selection of varieties suitable both for the locality and the class of trade to be supplied. Mistakes in this direction are easily made from failure to appreciate the difference between garden and plantation conditions. The object of this article is to point out both the good and bad points of the varieties commonly grown, and to assist the grower generally in choosing those most suitable for the purpose he has in view.

In many parts of the country where the climate is mild, the growing of pears under plantation conditions, either as "fillers" or in blocks, is a paying investment. The area devoted to this class of fruit is on the increase, but the demand for good quality pears, especially from October to December, is very great, and there is room for a considerable increase in production.

Factors influencing the Choice of Varieties.—(1) *Marketing.*—The quality of different pears varies very considerably, but the very high-quality kinds do not as a rule prove the most profitable commercially, as they are generally shy croppers. It is unfortunate that there are few varieties combining the characteristics of high quality and fruitfulness together with hardiness, and in selecting varieties one is often obliged to sacrifice quality in order to obtain a paying quantity. Roughly the chief pear varieties may be divided into three classes:—

(*a*) Very high quality pears, shy in bearing and requiring exceptionally favourable conditions. The culture of these in this country is almost entirely confined to private gardens, where quality is of prime importance and monetary return a secondary consideration. A small part of the trade is supplied from home sources and the bulk comes from abroad.

(*b*) Medium quality kinds which crop well and thrive over a fairly wide range of soil and climatic conditions. These are the varieties chiefly grown for market in the southern fruit districts, and are suitable for the general retail trade. Taken as a whole, they usually bring very fair returns.

(*c*) Poor quality early pears, very hardy and usually heavy cropping. These usually are sold for the cheap retail, coster and seaside trades. On account of their earliness and their heavy crops they are often very profitable in

spite of their poor quality. This is especially the case where growers are near seaside towns and can supply the retail trade direct.

A succession of varieties should be selected, so that picking and marketing are spread over as long a period as possible, and —in the case of the grower who sells direct to retailers—a continuous supply should be maintained.

(2) *Method of Cultivation.*—Standard and half-standard trees which are grafted on pear stocks are not generally recommended. They are so slow in bearing that often a profitable crop is not obtained until 20 years have elapsed after planting, and the fruit from this form of tree is not of such good quality as that from bushes or cordons, owing to the greater attention which the latter receive.

Bush pears on quince stock are preferable, for their habit of growth is generally upright and the trees come into bearing a very few years after planting. As " fillers " they are ideal, as they are somewhat short-lived and are usually past their prime by the time their removal is necessary. Unlike many apples, pears crop well on a system of close spur pruning and restrictions, and they are, therefore, particularly suitable for cordons. This system entails a high cost of production, and should only be adopted for the best of the commercial varieties, where locality and situation are favourable, on suitable land in good heart, and when it is quite certain that the trees will receive the necessary amount of attention.

(3) *Locality and Soils.*—Pear growing—especially of high quality varieties—is mostly confined to districts with a mild climate, and for this reason the South Western Counties and many districts with suitable soils bordering on the English Channel are particularly suitable.

Pears worked on Quince require particular soil conditions, but as a general rule it can be taken that in their likes and dislikes they follow closely apples worked on the weaker types of Paradise. The ideal soil is a sandy retentive loam with good natural drainage; brickearth with a slight mixture of sand is particularly suitable. They require good land and do not thrive on extreme types of soil such as cold wet clays or thin soils on chalk or gravel, but there is a wide range between these on which they can be profitably grown. Local information as to the suitability of a district and the soils therein can usually be obtained and should be given due consideration, especially in relation to the fruitfulness of a variety and its power to resist disease.

Description of Market Varieties of Pears.

Variety and Season.	*Description.*
BEURRE CLAIRGEAU Nov.	Culinary. Large, lemon yellow tinged with orange red. Strong and upright grower. Said to bear profitably in the North.
BEURRE DE CAPIAUMONT Oct.	Dessert, medium quality. Medium size, pale yellow covered with russet tinged with red. Succeeds in the North.
CAILLOT ROSAT Aug.	Dessert, good quality. Medium size. Greenish yellow with brownish red cheek streaked with red. An excellent bearer where at home, as it is said to be in the North.
CHALK (CRAWFORD) Aug.	Poor quality dessert, but fairly regular cropper. Often planted as a standard for a windbreak. Too many should not be planted, as it must be marketed just before it is ripe.
CONFERENCE ... Oct.—Nov.	Dessert of good quality. Medium size, and very long necked, yellowish green, much russeted. Growth upright and strong in good soils, but should be grown on pear stock on poorer land. Owing to its regular and heavy cropping powers a popular and reliable market variety.
CLAPP'S FAVOURITE Mid. Aug.—Sept.	Dessert, of good quality, but becomes mealy if kept too long or allowed to ripen completely on the tree. Medium size, shape uneven. Bright yellow with bronze or crimson cheek and deep crimson stripes. Growth moderately strong and upright. Crops well, and is a valuable market variety. Responds to double working.
CATILLAC ... Dec.—April.	Culinary, good quality. Large, dull green with brown red flush. Growth strong and spreading, somewhat pendulous. A hardy and useful variety, but a little uncertain on some soils.
Dr. JULES GUYOT Early Sept.	Dessert, very similar to Williams in appearance and quality, but must not be allowed to ripen on the tree, and does not keep long. Large, lemon yellow with black dots and generally a red cheek. Regular cropper. Growth weak and compact. Responds well to double working.
DOYENNE DU COMICE Nov.	The finest and highest priced dessert pear grown. It frequently fails to crop well. Should only be planted experimentally at first.
DURONDEAU ... Oct.—Nov.	Dessert, good quality. Large, a deep russet brown with a crimson flush. A regular and free cropper. Growth strong and upright. A good market variety.
EMILE d'HEYST Oct.—Nov.	A valuable dessert variety of very good quality. Light yellow with patches of russet. A fairly good cropper, but not reliable in all situations. Moderate and irregular growth.
FERTILITY ... Oct.	Fair quality dessert. Medium size, russet with an orange tinged cheek. Regular and heavy bearer. Growth moderate and upright. Makes an excellent bush. Should be grown on pear stock on the poorer soils. Has immense cropping powers. Liable to canker.

Variety and Season.	*Description.*
HAZEL OR HESSLE Oct.	One of the most profitable of the small pears; a very heavy cropper and vigorous grower. Especially useful where more tender varieties will not succeed.
LAMMAS ... ... Aug.	May be described in the same terms as Hazel, but too many should not be planted as it must be marketed as soon as ready. A long time coming into bearing.
LOUISE BONNE OF JERSEY Oct.	A dessert pear of high quality and somewhat unusual flavour. Medium size; yellowish green with a dark red cheek. Growth medium and upright. A very valuable variety in a congenial situation, when it is a heavy and regular bearer, but in other situations is liable to suffer from frost.
MARGUERITE MARILLAT Sept.	A dessert pear of quite good quality. Very large; orange yellow with red flush and patches of russet. Growth strong and upright. Bears freely in a warm and sheltered situation.
MARIE LOUISE d'UCCLE Oct.	Large dessert of quite good quality if not left too long on the tree, but does not keep long. Skin marked with pale cinnamon russet. Tree of good growth and shape. Generally a very heavy cropper, but care should be taken to market before ripe.
MOOR FOWL'S EGG (Muirfowl's Egg) Oct.	An old Scotch dessert pear of fair quality, and rather below medium size. Yellowish green, with a mottled red cheek and covered with pale russet dots. A reliable cropper and vigorous grower; is hardy in Scotland and the North country.

(This article is also issued as Leaflet No. 347.)

LAND DRAINAGE.

The Improvement of Watercourses.—The Land Drainage (Ouse) Provisional Order Act, which has now become law, is a measure of great importance, and is one of the first concrete results of the passing of the Land Drainage Act in 1918.

In all low-lying districts the prosperity of agriculture depends essentially upon the maintenance of the main watercourses in such a condition that floods can be controlled to the greatest possible extent, and flood-water prevented from lying on the land long enough to impair its fertility.

The present condition of most of the great rivers in England is lamentable, and it has arisen in almost every case from the absence of a Central Authority possessing the power to control the whole river and to hold a fair balance between conflicting interests. The Ministry has long felt that the Great Ouse is a case where the need for such an Authority is the most urgent. It was clear from the beginning that, owing to the number of important local Drainage Authorities—some of them upwards of 300 years old—which already existed to look after local interests, and to the number of divergent interests which had to be safeguarded, the establishment of a Central Authority for the Great Ouse would present very serious difficulties. At the same time, it was thought that if the soundness of the Ministry's policy could be established in such a case, an example would be set which could hardly fail to be followed on the other great river systems throughout the country.

The Ouse Provisional Order was settled by the Ministry with the loyal help of the majority of the drainage and other Local Authorities concerned, but was very strenuously opposed by a small minority of Authorities and individuals. This opposition led to a debate in the House of Commons, and to a most exhaustive discussion before Committees of both Houses of Parliament. The result has been that the policy of placing the whole of each river system under a Central Authority, responsible for all sections of the main channels, has been completely vindicated. The principles embodied in the Ouse Provisional Order were upheld in their entirety by Parliament, and the alterations made by the Committees were in matters of detail only, and were all made, with one exception, either at the instance or with the consent of the Ministry.

Besides the main principle of policy already referred to, certain

other vital principles of general application were discussed and upheld by the Parliamentary Committees. The two most important are the following:—

(1) *No Taxation without Benefit.*—The general law does not permit of the rating, for the maintenance of a river, of the whole of the high lands within the watershed. Only such lands as may suffer from the bad condition of some part of the river can be taxed. Whether any alteration of this law is desirable or not, both Committees held strongly that the establishment of Drainage Authorities is a matter which should not be delayed upon any pretext.

(2) *No Benefit without Taxation.*—Wherever land is benefited by drainage works, it is proper that it should contribute to the carriage, right down to the sea, of the water from which it is freed by those works. This principle was discussed at very great length before both Parliamentary Committees, and was emphatically endorsed by them. The Committees also upheld the contention that the benefit derived from the maintenance of main channels is not confined to "land liable to flooding."

Of the principles, which are embodied in the Ouse Act and which were not disputed before Parliament, the most important are (1) that there should be no qualification for voting at Drainage Board elections except the owning or occupying of lands in the district and the payment of all rates due; (2) that membership of the Drainage Board should be open to all owners of not less than 10 acres and to all occupiers of not less than 20 acres within the district; and (3) that the Drainage Board and the County Councils should be kept in close touch with one another, by a small proportion of members of the Drainage Board nominated by the County Councils.

It is essential for the welfare of agriculture that in setting up Drainage Authorities the *river* should be regarded as the unit of administration, regardless of the fact that it may flow through a number of counties. In many cases a river is itself the boundary between counties, or is crossed and recrossed by the county boundary in many places. In all such cases it is obvious that the county boundary must be disregarded, and the problem must be viewed as if counties, as such, did not exist. Indeed, there is only one case in England—the Yorkshire Ouse—of a great river being in one county only, and even there, owing to the administrative division of the county into Ridings, false issues are raised and differences of a non-essential nature appear at first sight as serious difficulties.

Having obtained, by the passing of the Ouse Drainage Order into law, the establishment of so important a principle, it would hardly be possible for the Ministry to stand still in its task. The improvement of the Yorkshire Ouse and Derwent, and the plains through which those rivers flow, is an equally pressing work which is receiving the attention of the Ministry. A measure creating a Drainage Board for that purpose is already under discussion, and it is hoped that before long all those who are interested in the improvement of agricultural conditions in Yorkshire will have full opportunities of considering its provisions. It is also to be hoped that those provisions will command such a measure of general assent, in the light of the recent discussion of the Ouse Bill, that no further reference to Parliament will be necessary.

It must be plain to all who will consider the question impartially that if farming in the low-lying districts of England (which are also the most fertile) is to prosper as it should, some active and immediate measures must be taken to improve the condition of the rivers. No such measures are possible without full co-operation, and a certain amount of "give and take," between the various interests in the drainage area of the whole river.

The Powers and Conditions of Drainage Boards.—The powers of Drainage Boards cannot be better summarised than in the words of the Land Drainage Act of 1861, which lays down that they extend to the following undertakings:—

(1) "To cleansing, repairing or otherwise maintaining in "a state of efficiency any existing watercourse, out-"fall, or defence against water;"

This is called technically "The maintenance of existing works."

(2) "To deepening, widening, straightening, or otherwise "improving any existing watercourse or outfall, "removing weirs or other obstructions, or raising or "altering any defence against water."

This is called technically "Improvement of existing works."

(3) "To making any new watercourse, outfall, or defence "against water, or erecting pumping or other "machinery."

This is called technically "the construction of new works."

All these powers are subject to various restrictions for the protection of property and other interests, and new works or improvements of existing works can only be carried out after due notice has been published and opportunities given for ratepayers to object. Any such works which would cost over £1,000, or over £1 per acre of the lands which would be rated for them, can be vetoed by the objections of the owners of one half of such lands.

To pay for the expenses incurred by a Drainage Board, the Board levies rates on all lands in its district which derive any degree of benefit from its works. Rates for "maintenance" are levied on occupiers, and rates for "new works" or "improvements" fall upon owners. Payment for "new works" or "improvements" is frequently spread over a period not exceeding thirty years.

No rates can be levied on lands which derive no benefit from the Board's operations, but as there are limits to the amount of sub-division which can be made, it is usual to "pool" expenses to a considerable extent.

The only kind of Drainage Authority which can be established by the Ministry of Agriculture is that known as an "Elected Drainage Board."

The first members of the Drainage Board are obliged by statute to be named in the Order which establishes the Board. They only remain in office, however, until an election can be held, which is usually from twelve to eighteen months after the date of the Order. During that time they are mainly engaged in preparing the rate-books and registers of electors, determining the staff required, and beginning such work as may be obviously necessary and urgent. When the first members retire, at least a majority—usually about two-thirds—of the members must be directly elected by the ratepayers (owners and occupiers) in the several areas which they represent. Thus the policy of the Drainage Board depends upon the views of the electors. A small number of members are appointed by County Councils or other authorities or corporations who have special interest, and with which it is desirable that the Drainage Board should keep in close touch.

It has frequently happened that inquiries have been held as to the steps which should be taken to put some river into perfect order, and as to the cost which would be involved. Distinguished engineers have elaborated schemes of works, usually involving very heavy expenditure, and nothing further

has been heard of the matter for many years. It is sometimes thought that the Ministry, in endeavouring to establish a Drainage Board, is conspiring to force the carrying out of one or other of these elaborate engineering schemes, and that on the establishment of such a board the district will suddenly be burdened with intolerable expense. It must be stated with the greatest emphasis that this is not the case. A Drainage Board at the outset of its career is faced with the heavy task of preparing the way for its successors, and must necessarily feel its way slowly in the matter of works. Its ultimate policy and the amount of money it spends will depend (as has already been pointed out) upon its electors. So long as a board makes reasonable use of its powers it is subject to no outside interference from any quarter. The object of the Ministry is to establish on each river system an authority which will view the problems presented by the whole system as a whole, and will have legal powers to deal with them.

THE DORSET ARTS AND CRAFTS ASSOCIATION:

A SUSTAINED AND SUCCESSFUL EFFORT.

Miss M. B. Mansel,
Secretary to the Association.

The Dorset Arts and Crafts Association was started in 1905, with the object of encouraging handicrafts work in the county. An Executive Committee was formed, and lists of articles, the manufacture of which it was intended to promote, were drawn up. These were adapted from those in use by the Wiltshire and Somerset Associations, which had been in existence for some years. From the first there was no doubt of the popularity of the movement. Exhibits of all kinds and qualities poured in, the result of many years work of "home industry." It was considered desirable at the commencement not to be too drastic in disqualifying any exhibit, and so possibly damping the enthusiasm of an exhibitor, but rather to encourage every kind of effort until the exhibitors gradually learnt the type of article which would be most useful and likely to command a sale. Exhibitions are held annually in the county, and inferior work has dropped out, in consequence, and the exhibits have become less numerous, but the quality and workmanship have improved.

In the early days of the movement there were not many organised classes in the villages, and only a few in the towns, but, with the assistance of grants from the Association to meet the initial expense of starting classes, and to cover such incidental expenses as material, tools, lighting and heating, and the holding of the annual Exhibition, instruction is now being given on a large scale, and much pleasant and profitable employment is provided. Basket, leather and metal work, and ornamental and useful needlecraft classes were organised in the villages and small towns, and in a short time were working well and soon became self-supporting.

Class work and co-operation among the members are essential to the success of an Association. A number of exhibits of the same kind from one class promotes competition, and results in the work being more skilfully executed. A class will soon acquire a reputation for good work, and if reliance can be placed on the goods made, orders for large quantities may be received. When several members of one class work together

production is increased in greater proportion. Individual contributions to any section of the schedule of articles are admitted from any resident in the county (residence is the only qualification), and much that is beautiful is sent. Professional industries also have their place, and serve to advertise work done in the county; pottery, gloves and, occasionally, toys being conspicuous exhibits.

At first the various awards in the section were competitive, first and second-class certificates being offered, but it was found that this system was impracticable when there was a large number of exhibits. The Association therefore adopted the Home Arts Association's principle of merely awarding a certificate of merit to articles which attained a certain standard. A high standard was required, but when it was not quite reached "commended" cards were allowed occasionally, where the judges considered that some recognition was deserved. It is a condition of the Association that no member is eligible to teach in the industry she wishes to take up unless she has gained an award at an Exhibition.

At the outbreak of war, several of the boys' and men's classes were necessarily suspended, and difficulty has been experienced in resuming them, owing to the large increase in cost of raw material. In time, however, it is hoped that some of the difficulties may be overcome. The birth of the "Women's Institute" movement* during the War provided a fresh outlet for co-operative work, the objects of these Institutes being to a certain extent similar to those of the Arts and Crafts Association. They have their own "instructors" in the various forms of handicraft, and have sent much good work to the Dorset Arts and Crafts Exhibition; chiefly toys, rush work and gloves. The qualification of the Instructors consists in their work having received distinctive notice from the judges at the Arts and Crafts Exhibition.

By means of the annual Exhibition members are able to see the result of the year's work. Different centres are chosen every year, so as to stimulate local interest as much as possible. The Exhibitions have been held for fourteen consecutive years since the inception of the Association, and during the War a special "Red Cross" stall was included, containing the work of wounded soldiers. In 1917 Her Majesty the Queen presented an "American home canner" to the Dorset Arts and Crafts

*Notes on Women's Institutes have appeared in this *Journal*, January, 1917, p. 966, October, 1918, p. 827, December, 1919, p. 939, and June, 1920, p. 206.

Association as a token of her appreciation of work carried on in difficult times.

Each succeeding year the Association has grown in its usefulness to the county. Many of the handicrafts travel far, even to America and Canada, while awards have been gained at the Home Arts Association's Exhibition in London and at other centres. The joy of creation is becoming a real stimulus in the minds of the workers, who take a delight in producing a new toy or in designing a fresh pattern, and eagerly look forward to the judges' "reports" upon the meritorious articles. To advertise the dignity of labour and self-help and to encourage neatness in execution are the aims of the Association, and each year shows considerable advance in this direction. The happiness of those who produce and also of those who work with and for them has a moral influence which all must feel who are really interested in what concerns the good of others, and what certainly contributes to the prosperity of a Nation.

INSECT AND FUNGUS PESTS DURING THE WINTER:

THE IMPORTANCE OF PLANT HYGIENE.

GEO. C. GOUGH, A.R.C.Sc.,

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WITH very few exceptions, such as the winter moths, one species or another of which is in evidence about this time in the adult moth stage, pests are in a dormant or semi-dormant condition during the winter months. Many of these pests are to be found among the refuse of the crops, and it is therefore essential that the grower should be hygienic in his methods. Plant hygiene or sanitation is increasingly necessary in these days of high cost of labour, and growers are recognising that it is in the end more economical to spend money on improving hygienic methods and so kill a smaller number of parasites while in a dormant condition than to delay action in the hope that the pests may be effectively removed later.

Fungus Pests.—A large number of the pests are associated with the soil, and, more especially the fungus spores, are extremely difficult to kill. In the case of some, such as those causing Wart Disease of potatoes, no practical method of killing by treatment of the soil has been discovered. Another potato disease, Corky Scab, is also perpetuated by infected soil, and no varieties of potatoes are known to be immune from the disease. In the latter case, however, there is good reason to believe that the disease is due largely to wet soils and that drainage may be a remedy, while it is possible that investigations may reveal a chemical which will prove an effective fungicide. Another very common soil pest is Club Root (or Finger-and-Toe) of turnips and cabbages. On many soils this disease may be kept in check by liming, as the fungus propagates itself best on acid soils. In most instances a heavy dressing of lime is needed, even up to 4 tons per acre. Curiously enough, the fungus causing Corky Scab requires the opposite conditions, the disease being more evident in limy soils.

Insect Pests.—Animal pests in the soil are most effectively controlled by working the land frequently so as to give the birds every opportunity of discovering the insects. It has been noted that grease bands on trees on arable land have caught fewer moths than those on trees growing in grass.

The idea of ridging up the land in winter to allow frost to kill insect pests, although excellent from a cultural standpoint, does not seem to stand the test of experience, for insect pests, even when in a dormant condition, can apparently endure the frost, while many fungus spores germinate better after being frozen. Soil fumigants containing a basis of napthaline are far from being successful generally, although they may enable a crop to become established and so to withstand injury.

Infected Crops should be Removed.—Growers, whether on a large or small scale, should realise that vegetables such as turnips, potatoes, and mangolds which have suffered from fungus disease contain thousands of spores, and it is important that these crops should not be left about to rot or be fed unboiled to animals, as in both cases the spores are by such means returned to the land. Stubble frequently contains the pupæ of flies from the preceding crop. To destroy the pests the stubble should be ploughed in very deeply, or preferably burnt, even though extra trouble may be involved.

Weeds.—Weeds should not be overlooked in this connection. Grasses and weeds on the headlands and weeds in the field are constantly the alternate hosts of pests which would otherwise starve in the interval between the crops.

Fruit and Garden Pests.—The need for the adoption of sanitary methods is perhaps more important to the fruit grower, commercial gardener and allotment holder than to the farmer, since a large number of fruit and garden pests, both insect and fungus, hibernate on the refuse. The refuse heap and manure heap are equally the resort of these parasites, and become a hotbed of disease. A long list might be made of pests of garden crops which could be found in most heaps of unburnt refuse and which will ultimately find their way to the new crop, unless destroyed.

The refuse of the fruit grower largely takes the form of dead wood, although diseased leaves and fruit are common. Except in cases of high wind, fruit which falls prematurely is usually diseased, and should be gathered and burnt or fed to pigs. Very few fruits bear fungus spores which are not destroyed by passing through animals, so that the danger of infecting manure is very slight. Insect pests are readily destroyed, and where possible, fowls should be allowed the run of the orchards, as they are fond of insects and prevent many caterpillars and other larvæ from entering the soil to pupate.

Many leaf spots and other leaf diseases which cause premature loss of foliage are carried through the winter by the fallen leaves. Such leaves should be raked up and burnt.

The pruning of trees and bushes is usually undertaken for the purpose of shaping the growth and allowing light and air to penetrate the foliage, but where the operation is done properly the spread of disease is effectively checked. Wounds, however, should be treated antiseptically to prevent further disease. It is now known that reinfection in several fruit and leaf diseases, such as Brown Rot of plums and apples and Apple and Pear Scab, takes place from infected twigs and spurs, as well as from " mummied " fruit, so that these should be carefully cut away. Dead wood should be removed from plum trees, as Silver Leaf is often caused by such remaining on the tree. *Stereum pupureum*, which causes the disease, only produces its spores after the wood has been killed. It is for this reason, and also because dead wood on a tree is useless and a danger, that the Ministry's Order compelling the removal of dead wood from plum trees before the 1st April of each year was made. It is important that the dead and diseased wood removed should be burnt, as many of the destructive fungi continue to develop after the wood has been removed from the tree. Before the Silver Leaf Order came into operation piles of wood, and even posts and fences, could commonly be seen, on which the causal fungus was breeding and reinfecting hitherto clean trees.

Spraying.—Spraying is an effective means of controlling the ravages of pests. A normal winter spray usually has as its basis caustic soda. A caustic soda spray will remove lichen, moss and other parasites on the bark of trees which serve as a place of refuge for insect pests. A solution of copper sulphate is sometimes used to kill fungus spores. Lime-sulphur solution has the merit of being a cleansing agent as well as a fungicide, and is much in favour at the present time. This spray can also, if necessary, be used every year without injuring the bark, whereas the use annually of a wash made of caustic soda has an injurious effect on the trees.

Spraying should be done after pruning, although not necessarily immediately afterwards. The best results are obtained when the operation is deferred as late as possible. It is commonly stated that the solution should be applied " before the buds swell," but in practice it is better to wait until the buds have swollen, or even after they have commenced to open,

although a slight scorching of the edges of any exposed leaf may follow. The reason appears to be that the eggs of insects or resting spores are but little affected by the wash. The pests are most vulnerable and are easily killed. The best results are obtained when the spores have germinated or the eggs have hatched, which is usually about February.

Lime spraying done late is often effective, and not only cleans the trees but, when properly done, encases insect eggs and so prevents hatching. Even when hatching takes place the insects have difficulty in moving about in the particles of lime.

In conclusion, attention should be paid to the general health of trees. Too little care is given to the roots of trees, although the branches may be well attended to. Many growers appreciate the fact that the leaves breathe and must have light and air to do their work properly, but few realise that the roots also respire and cannot function properly unless the soil is well drained and kept open, so as to allow the air to circulate between the particles of soil. It has sometimes been held in the past that old-established trees require no manure, but it is now recognised that a tree cannot do its best unless it is supplied from time to time with sufficient food which the manure supplies. In this connection it should be remembered that plums in particular require lime, and that probably other fruits need similar special constituents, although little is known at present as to the requirements of particular plants.

FEEDING STUFFS IN NOVEMBER.

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THERE is a slight downward tendency in prices since last month, and reports at the present time seem to indicate the probability of an appreciable fall in the price of many commodities, which may extend to feeding stuffs. Some feeding stuffs have advanced in price, notably palm kernel cake, which is, however, still cheap as compared with other materials.

Several correspondents have asked for particulars of the prices quoted in these notes. These prices are quoted from the Weekly Return of Market Prices issued by the Ministry of Agriculture. They represent prices at which actual wholesale transactions have taken place on the larger markets, usually London, and refer to the price ex mill or store. They are as a rule considerably lower than the prices on local country markets, the difference being due to carriage and dealer's commission.

Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £15 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £12 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 3s. 6d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·88d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

At the request of another correspondent particulars of the relative food value and prices of potatoes, swedes and mangolds have been added to the table. The figures given have been worked out backwards from the assumption that the starch equivalent of these foods is worth about the same as that of starchy foods such as maize, namely, 2d. per lb. The figures show that with maize at its present price, the value of potatoes for feeding is about £4 17s. per ton, and of swedes or mangolds about £1 10s. per ton.

Potatoes being very starchy in composition are quite suitable for replacing maize meal or other cereal products. Since the starch equivalent of potatoes is 18 and that of most cereal meals about 70, the replacement should be made in the proportion of 4 parts of potatoes for 1 part of meal.

NOTE.—Beginning with the December issue of this *Journal* the notes on Feeding Stuffs will no longer be written by Professor Wood, but will be prepared in the Intelligence Department of the Ministry.

NAME.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
	s.	lb.	£ s.	£ s.	£ s.		s.	d.
Barley, English Feeding	78/-	400	21 15	1 6	20 9	71	5/10	3·14
,, Foreign	75/-	400	21 0	1 6	19 14	71	5/7	3·00
Oats, English	57/-	336	19 0	1 9	17 11	59·5	6/0	3·22
,, Foreign	54/-	320	18 15	1 9	17 6	59·5	5/10	3·14
Maize	75/-	480	17 10	1 5	16 5	81	4/-	2·14
Beans, English spring	98/-	532	20 10	3 1	17 9	66	5/4	2·86
,, ,, winter	96/-	532	20 0	3 1	16 19	66	5/2	2·78
,, Chinese	19/-	112	19 0	3 1	15 19	66	4/10	2·60
Peas, English blue	105/-	504	23 5	2 13	20 12	69	6/-	3·22
,, ,, dun	103/-	504	22 15	2 13	20 2	69	5/10	3·14
,, ,, maple	113/-	504	25 0	2 13	22 7	69	6/6	3·50
,, Japanese	150/-	504	33 0	2 13	30 7	69	8/10	4·75
Buckwheat	—	—	—	—	—	—	—	—
Rye, English	84/-	480	19 10	1 8	18 2	72	5/1	2·73
Millers' offals—Bran	—	—	14 10	2 10	12 0	45	5/4	2·86
,, ,, Coarse middlings	—	—	15 10	2 10	13 0	64	4/1	2·20
Barley meal	—	—	24 0	1 6	22 14	71	6/5	3·45
Maize ,,	—	—	21 0	1 5	19 15	81	4/11	2·65
Bean ,,	—	—	22 0	3 1	18 19	66	5/9	3·09
Fish ,,	—	—	24 10	7 12	16 18	53	6/5	3·45
Cakes, Linseed	—	—	23 10	3 12	19 18	74	5/5	2·90
,, Soya	—	—	24 0	5 4	18 16	69	5/6	2·95
,, Cotton seed	—	—	14 0	3 5	10 15	42	5/2	2·78
,, Cotton seed decorticated	—	—	19	5 6	13 14	71	5/10	2·06
,, ,, decorticated meal	—	—	20 0	5 6	14 14	71	4/2	2·24
Coconut cake	—	—	16 0	3 0	13 0	79	3/4	1·80
Groundnut cake	—	—	16 10	3 9	13 1	57	4/7	2·46
,, decorticated	—	—	21 0	5 5	15 15	73	4/4	2·33
Palm kernel cake	—	—	13 0	2 1	10 19	75	2/11	1·57
,, ,, meal	—	—	—	2 1	—	75	—	—
Brewers' grains, dry	—	—	11 15	2 7	9 8	49	3/5	1·83
,, ,, wet	—	—	0 17	0 12	0 5	15	0/4	0·18
Distillers' ,, dry	—	—	12 10	2 16	9 14	57	3/5	1·83
,, ,, wet	—	—	1 1	0 13	0 8	16	0/6	0·27
Malt culms	—	—	10 5	3 6	6 19	43	3/3	1·75
Potatoes	—	—	4 17	0 8	3 9	18	3/10	2·00
Swedes	—	—	1 12	0 5	1 7	7	3/10	2·00
Mangold	—	—	1 9	0 6	1 3	6	3/10	2·00

AGRICULTURE ABROAD.

THE CINEMA IN AGRICULTURAL EDUCATION—A NEW METHOD OF TESTING MILK—SMALL HOLDING FARMING.

The Cinema as an Aid to Agriculture.

In every branch of education the cinema promises to play an important and ever-developing part. This means of providing instruction in agriculture and horticulture has received the attention of the United States Department of Agriculture, and a scheme of circulating films illustrating agricultural methods and subjects has been devised, which has already met with a large measure of success. At present well over 100 films have been prepared for circulation. The number of reels available for distribution is 460, representing more than 460,000 feet of film. All the pictures are in circulation, most of them constantly, and it is calculated that in the last twelve months more than 700,000 persons have witnessed exhibitions of one or more of the Departmental films. The authorities are assured that their enterprise in this direction is making for better farming.

The official films are intended primarily for the instruction of " extension " students, field workers and co-operative agricultural institutions. The Department is at present unable to meet all the demands made from outside sources upon its supply, but where reels are not actually in use, every endeavour is made to lend them to societies not directly connected with the Department. No charge is made for the loan of the film, but the borrower is expected to pay the cost of carriage.

Among the subjects illustrated in this manner are the keeping of live stock, the life history of injurious parasites, dairying operations, the raising of crops, gardening, forestry, market operations, agricultural chemistry, biology, farm management and building construction. The spectators are, for example, shown the entire process of the wool industry—the flocks grazing in the national forests, the separating of lambs from ewes, feeding, shearing and marketing; the after history of the fleece, sorting and weighing, until it reaches the factory, where the cleaning, grading, spinning, winding and weaving processes carry on to the finished web of cloth.

The whole organisation of the poultry farm is shown, and the scientific side of the question is treated in a most interest-

ing series depicting the embryology of the egg. A film entitled "The Construction of a Wooden Hoop Silo" shows in fifteen minutes an operation that would require a full day to demonstrate if the class were taken to a farm where such a building was in progress. An excellent film, devised as a pleasant story, has been prepared as an auxiliary to the promotion of rural industries. While it imparts instruction, this film introduces the personal element, and so maintains the kinship of the cinema with recreation. The picture is entitled "The Home Demonstration Agent"—a United States official whose duty corresponds to that of one of the county organisers in domestic science in this country. This lady's work among women and girls in outlying country districts is faithfully traced, and its effects on the whole community are brought home to the audience. The little drama introduces the work of the egg-circle, the communal kitchen, the county encampment and picnic, and the exhibition of club work at the county fair.

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The Hoyberg Process of Testing the Fat Content of Milk.

THE large development of the milk trade, and also the establishment of butter factories and creameries, call for great care in ensuring that the milk purchased or sold is pure and of good quality. The percentage of non-fatty solids in milk is fairly constant, but the fat or cream content varies, and it is necessary for tests to be made from time to time to determine whether the amount of fat in the milk is or is not below the "standard." Such tests are commonly made with an apparatus known as the butyrometer, invented by Dr. Gerber. This apparatus consists of a number of test tubes in which the milk can be specially treated for testing. Definite quantities of milk and acid are mixed in a specially constructed test tube, and the tube is rotated at high speed. The fat is in this way separated from the remainder of the milk, and driven into a narrow tube graduated so as to enable the percentage of fat contained in the sample to be measured.

A method of testing the fat content of milk on somewhat similar lines has recently been designed by Mr. Hoyberg, Veterinary Officer to the Commune of Frederiksberg, Copenhagen, and has attracted some attention in dairy circles. Observations on this process have been made by three

authorities on dairying*, and an account of their investigations and conclusions was published in the issue of the *Milchwirtschaftliches Zentralblatt* for 15th April, 1920. The results suggest the possible value of the Hoyberg process as compared with the Gerber process, although it should be stated that Hoyberg's investigations are not yet complete.

Each butyrometer in the Hoyberg process is filled with 9.7 cc. of milk, to which are added 3.4 cc. of one and 0.6 cc. of a second fluid (both of secret composition), carefully measured, and the tube then closed with a rubber stopper. The contents are mixed by turning the butyrometers five or six times, shaking for ¼ minute, and again turning as before. The tubes are afterwards allowed to stand in a water bath at a temperature of 60° to 62°C., stoppers uppermost, for 6 or 7 minutes, after which the previous operation of turning and shaking is repeated. The butyrometers are finally again placed in water, stoppers uppermost, for 8 to 10 minutes, and then in a reverse position for a further period of 5 to 10 minutes.

As a result of this treatment the fat is separated from the rest of the milk. The amount can be read off on the graduated scale.

The whole apparatus and fluids can be packed in a well-fitted tin box, which is easily portable.

In the account given by the three investigators, the results of five samples of milk so treated are tabulated, and it is shown that they correspond very closely with those obtained by the Gerber process. One-half of the milk used was preserved with formalin (one drop to 50 cc. of milk), and the other half cooled, and further tests were made on the following day. These results showed differences in some cases up to 15 per cent., and in one case (in the milk preserved with formalin) 20 per cent. Further tests with other samples of both whole and thin milk were made later, and generally confirmed the results previously obtained.

Mr. Hoyberg mentioned the following three points with regard to his process:—

(1) Investigations are not yet complete as to whether the process is suitable for milk from cows just calved, for milk from dry cows, or other abnormal milks.

(2) The process is unsuitable for skim-milk, as the results given are too low.

*B. Van der Burg, Professor of the Agricultural High School of Wageningen; W. Keestra, Director of the State Dairy School, Bolsward; and D. C. de Vaal, Director of the Cheese Central Station, Alkmaar.

(3) When milk samples have to be kept, the preservative to be used must be formalin. It would appear that bichromate of potassium is ill adapted for this purpose, but investigations on this point are not yet complete.

In discussing the results of their observations from the experiments, the writers state:—

(1) With fresh milk the agreement between the Hoyberg and the Gerber process is fairly accurate, provided that the fat determination process develops according to Mr. Hoyberg's desire, although differences up to 15 per cent., and in one case 20 per cent., occurred, and in general the Hoyberg method gives too low a figure.

(2) The process is easy to carry out and the rules are simple, although in spite of this simplicity some peculiarities occur which are difficult of explanation.

(3) In arranging the submersion in the water bath as a means for doing the necessary shaking, the inventor has made the shaking and turning portion of the process much less troublesome, although this was not borne out with the apparatus for six samples placed at the disposal of the investigators.

(4) In some experiments, in which three samples were tested, one sample in two butyrometers showed a dark fat layer or a flocculent serum, or both, whilst the other two samples remained perfect. In the course of the process of fat determination, also, more or less serious deviation in the readings was found. The investigators consider it quite possible that anyone making constant use of the Hoyberg method would find means of avoiding such undesirable occurrences; at the same time, it must always be a disadvantage that the investigator can, unconsciously, make small errors which could lead to a partial failure of the experiment and to erroneous conclusions.

(5) Reckoning up the time spent in carrying out Hoyberg's process in accordance with his rules, the investigators state that 25 minutes are required from the moment of closing the butyrometer until the time of reading off. This period is longer than with the Gerber process.

(6) The great advantage of Hoyberg's method over Gerber's is the omission of the shaking. The full advantage of this is not felt when the milk experiments are being made in a laboratory fitted up for this purpose, but it is a different matter if the experimenter has to go from one place to another to carry out his investigations.

(7) Milk tests for checking the yields of cows could be carried out on the spot more easily by the Hoyberg than by the Gerber method, and this, in certain circumstances, would mean a considerable simplification from the point of view of the milk tester.

(8) If, in regard to accuracy and reliability of results, the Hoyberg method fulfilled reasonable requirements—which the writers state as a result of their investigations they are not in a position to confirm—then it might perhaps replace the Gerber method in localities where it is extremely difficult and, at the same time, causes great loss of time, to collect all milk samples for investigation in a laboratory.

The writers sum up as follows:—

On account of its simplicity Hoyberg's method might be preferable to Gerber's in certain circumstances. This simplicity, however, gives rise to no saving in time, and on balance, does not outweigh the disadvantage that his process is less reliable.

* * * * * *

The Economics of Small Farming.

AT the present time, when the advantage of small holdings is so much discussed, it is instructive to turn to a report on the economics of small farms issued by the United States Department of Agriculture.* The Bulletin referred to presents the results of a study of the organisation of small farms in the neighbourhood of Washington, D.C. Information was obtained regarding the important and outstanding agricultural practices followed on 152 small farms, and an analysis was made of the business of each of these farms to ascertain the amount of capital used, the kind and quantity of crops raised, and of live stock kept, and the details of the financial position. Under the last head the investigator examined the nature and volume of receipts, the expenses incurred, the return realised, and other facts bearing on the organisation and operation of the holding.

The farmers visited were men whose main source of income was obtained from the produce of their farms. Each operator devoted most of his time to labour and supervision. Men who had a regular occupation elsewhere, and whose farming was merely recreative, did not come into the survey, as their work was manifestly not comparable with that of men who gave

*Bull. No. 848, United States Dept. of Agriculture, "An Economic Study of Small Farms near Washington, D.C."

their whole time to the land. The data presented apply to the crop year of 1916. The general conditions of yield and prices were fairly normal, as the effects of the European War had not yet materially changed farming profits or farm management in the region under consideration.

All the farms in question were devoted to market gardening. Over 50 per cent. of their total crop area consisted of vegetables and fruits, and 90 per cent. of the receipts were from this source. It was found that, judged by the farm standard, land values were high. The farm produce was disposed of by conveying it to the city and selling it either in the public market or through commission agents. As the farms increased in area the proportion of land used for general crops (corn, hay and grain) increased, but on many of the small holdings no corn or grain was raised, so that feed had to be bought. The live stock was limited to the horses required for farm work and to the cows, pigs and chickens kept for the production of food for the family. With the exception of poultry, sales of live stock were negligible.

The average flock was 33 chickens. In the area examined there were no green-houses for raising market vegetables. Of the farms inspected, the 45 showing the lowest investment had also the lowest income. The average crop area on these was 6 acres. In this group only five of the farmers made a labour income of over £80. Labour income is the amount of money left over after paying all business expenses and deducting interest on money invested. Farms under 10 acres in the region under consideration did not afford any great chances of large income, and it was noted that only the exceptional farmer can make more than a living on such small farms without any outside source of revenue. Incomes, however, rise very rapidly with the increase in the tillage area. A second group of holdings of 11-20 acres each make an average labour income of about £45, while two out of every five make over £80. Farms between 21-30 acres yielded incomes averaging over £80, and the same applied proportionately to the farms of over 30 acres.

The report points out that a farmer of 10 acres and under need not assume that he could not do better than the average, but must bear in mind that if he is to obtain more than the average income the most careful management and a considerable knowledge of farm practice and markets are necessary, while most of the farm work will have to be done by himself and his family. The small farmer has to buy nearly all his stock feed,

as he has not land enough to produce the more cheaply raised foods, such as hay, corn and green fodder. The larger farmer must spend relatively more money than the smaller for labour, fertilisers and marketing, but the costs for food are less.

One great source of profit is double cropping. The importance of having continuous cropping cannot be over emphasised. Many market-garden products reach maturity in less than a season. If it is not possible to follow or precede a short-growing crop with another market-garden crop, a winter cover crop or summer legume should be sown to be ploughed in for the improvement of the soil. Inter-cropping is also advantageous.

Two-fifths of the farms inspected had less than half their area in crops, the remainder being woodland, scrub and a negligible part in pasture. The half of the farms in crop had to pay interest and taxes on the non-productive part. As the tillage area decreased in proportion to the total farm area, the business became smaller, and in addition was burdened increasingly with idle capital.

When all the farms having 30 acres and under of tillable land are classified into two groups, (A) those in which the tillable area is 60 per cent. and less of the farm area, and (B) those in which it is over 60 per cent. of the farm area, it is found that the former group returned an average income of about £15, and the latter an average of £93. The disadvantage of leaving waste land idle is thus obvious.

The occupiers of the farms under consideration require a relatively small amount of capital. The farm income of the tenants was less than that of the owners, but if the net interest of the capital invested be deducted, the net income is about the same for both groups. The prospective farmer with the necessary experience but with little capital can do better by renting than by buying until he can afford to get a farm of sufficient size for profitable cultivation.

* * * * * *

Application for Licences under the Horse Breeding Act, 1918.—Owners of stallions who intend to travel their horses next season are reminded that they will require licences to enable them to do so.

Applications for licences in England and Wales may be sent to the Ministry on or after the 1st November, by which date the licences for the season of 1920 expire and should be returned to the Ministry. Failure to return any expired licence renders an owner liable to a fine of five pounds.

Forms of application for licences can be obtained from *The General Secretary, Ministry of Agriculture and Fisheries, Whitehall Place, London, S.W.1*, and, as the Ministry cannot undertake to arrange for the veterinary examination of stallions at short notice, owners are advised to send in their applications as soon as possible after the 1st November. If many defer doing so until the service season approaches it will not be possible to deal with all applications before the season commences.

Imported Seed Potatoes from Scotland.—The Ministry desires to bring to the notice of potato growers and merchants the revised regulations which are now in force with respect to the importation of seed potatoes from Scotland into England and Wales.

The Board of Agriculture for Scotland have recently issued an Order under which, in every case of a consignment of seed potatoes (other than certified stocks of immune varieties) to this country, the exporter in Scotland is required to obtain a certificate from the Board of Agriculture for Scotland to the effect that Wart Disease has not existed on or within one mile of the place in which the potatoes were grown. Further, the exporter must send with each consignment a declaration correctly stating the reference number of the relative certificate. In the case of certified stocks of approved immune varieties, the exporter must send with the consignment a declaration correctly stating the serial number of the certificate of purity issued in respect of the growing crop. The Ministry proposes now to supplement the Order of the Scottish Board by requiring that any importer who receives "seed" potatoes from Scotland which are not accompanied by the necessary declaration shall report the fact to the Ministry within seven days of the receipt of the potatoes. Any person desiring further information on this subject should communicate with the Ministry at 72, Victoria Street, London, S.W.1.

Export of Potatoes to Holland.—The Ministry has received official notice that the Netherlands Government have introduced regulations governing the importation of potatoes into Holland. These regulations require that potatoes grown in England and Wales shall be imported only in bags which have been sealed by an Inspector of the Ministry, and that at the time of importation a certificate must be produced from the Ministry stating that the potatoes were grown in land on which Wart Disease has not occurred. Growers and exporters of potatoes are warned, therefore, that they should not export to Holland any potatoes other than those which have been inspected by the Ministry. Immediate notification should be made to the Ministry by any persons desiring to export potatoes to Holland, in order that arrangements may be made for the inspection of such potatoes at the time of lifting.

Leaflets issued by the Ministry.—Since the date of the list given on page 690 of last month's issue of this *Journal*, the following leaflets have been issued :—

No. 346.—Gooseberries.
,, 347.—Profitable Pears for Market.
,, 355.—Growing Wild White Clover and Late-Flowering Red Clover for Seed.
,, 359.—Bracken as Litter. (Previously issued as Food Production Leaflet No. 16.)

In addition, the information in the following leaflets has been revised and brought up to date :—

No. 44.—Lapwing, Green Plover or Peewit.
,, 80.—The Use of Artificial Manures.
,, 151.—Cleanliness in the Dairy.
,, 161.—The Vapourer Moth.
,, 180.—Dodder.
,, 187.—The Selection and Milking of Dairy Cattle.
,, 197.—Agricultural Education and Research in England and Wales.
,, 250.—Domestic Fruit Bottling with or without Sugar.
,, 254.—The Use of Seaweed as Manure.
,, 274.—Parasitic Mange in Horses, Asses and Mules.
,, 314.—The Manurial Value of Shoddy.
,, 334.—How to Increase Stocks of Bees.

Foot-and-Mouth Disease.—*Sussex (East).*—No further development has occurred in this district, and the whole of the general restrictions imposed on account of the outbreaks near Uckfield in August last were removed as from the 26th September last.

Kent (Faversham District).—Two outbreaks occurred in this district on the 20th and 30th September at Baddlesmere, near Faversham, but no further extensions having occurred, the restrictions were removed as from 6th October from all but an area having a radius of about 5 miles from the outbreaks, in which movement remained prohibited. The restrictions applicable to this area were subsequently modified on the 13th October and removed as from the 21st October, except from two smaller prohibited areas around the actual premises on which disease existed. At the time of going to press (25th October) it is hoped that in the absence of any unforeseen developments it will be possible to withdraw all general restrictions from this district as from the 28th October.

Rabies.—*Wiltshire.*—One further outbreak of Rabies has occurred, at Salisbury, since the last issue of this *Journal*.

As a consequence of the confirmation of the case in the stray dog at Potterne, near Devizes, previously referred to, it was deemed necessary to extend the limits of the scheduled district on the West and North-eastern sides of the existing district, and at the same time to enlarge the limits of the inner controlled area.

Glamorgan.—No developments have occurred in this district, and the restrictions remain in force without modification.

Berkshire.—On the 23rd September, the existence of Rabies was confirmed at Reading. The dog, an aged fox terrier, first showed symptoms of illness

on the 19th September, and was taken to the premises of a Veterinary Surgeon, where it died two days later. In view of the suspicious symptoms, the case was reported to the Police and the dog's head sent to the Ministry's laboratory, where examination confirmed the existence of Rabies.

An Order imposing the usual muzzling and movement restrictions over a wide area around Reading was accordingly issued on the following day. This area comprises portions of the counties of Berkshire, Oxfordshire, Buckinghamshire, Surrey and Southampton. As from the 30th September, an inner or dangerous area having a radius of about 5 miles around Reading was prescribed. Within this inner area all dogs in a public place are required to be led as well as muzzled, and in any other place, not being a public place, to be muzzled at all times unless they are tied up or confined within an enclosure from which they cannot escape.

Since the original outbreak, three other outbreaks have been confirmed, viz., two on the 7th October and one on the 13th October, all at Caversham, Reading.

In consequence of the history attaching to one of the dogs concerned, it was necessary on the 7th October to extend the inner controlled area so as to include the district lying between Wallingford and Henley-on-Thames.

The movement of dogs out of the inner area and out of the scheduled district is prohibited except by licence of the Minister and subject to quarantine on approved veterinary premises.

Importation of Hops.—As there appears to be some misunderstanding with regard to the importation of hops, it is desired to state that hops may not be imported into the United Kingdom unless with a permit issued by or under the authority of the Food Controller. This regulation is imposed with a view to assisting the industry of hop growing in the United Kingdom to recover from the injury which it suffered during the War.—(*Board of Trade Journal*, 14th October, 1920.)

Free Entry for certain Agricultural Machinery into Tunis.—A Decree of the Tunisian Director-General of Finance, dated 3rd September, authorises the admission, free from Customs duty, of agricultural machinery and apparatus destined for the "Motoculture" exhibition to be held at Tunis in March, 1921. Machinery and apparatus imported duty-free under this Decree must be re-exported within two months of the closing of the exhibition.—(*Board of Trade Journal*, 14th October, 1920.)

SELECTED CONTENTS OF PERIODICALS.

A Strawberry Bibliography, *C. H. Payne.* (Jour. of Pomology, Vol. I., No. 4, Aug., 1920.) [01; 63.41(*c*).]

Variations in the Numbers of Livestock and in the Production of Meat in the U.K. during the War, *J. B. Guild.* (Jour. Roy. Stat. Soc., July, 1920.) [63.6 : 31; 63.75.]

Sawdust Chemically treated is tried as a Stock Food. (Hoard's Dairyman, Vol. LX., No. 4, Aug. 13th, 1920.) [63.604(*a*).]

Wart Disease of Potatoes, *G. C. Gough.* (Jour. R.H.S., Vol. XLV., Parts 2 and 3, July, 1920.)

On the relations between growth and environmental conditions of temperature and bright sunshine, *W. E. Brenchley.* (Ann. of App. Biol., Vol. VI., No. 4.) [575.]

Aus einer Feldstation für Stechmücken, *Dr. F. Eckstein.* (Zeits. f. angewandte Entom., Band VI., Heft. 2, 1920.) [59.169(*c*).]

Technic of Potato Starch Manufacture, *C. C. Moore.* (Potato Mag., Vol. 3, No. 1, July, 1920.) [63.344.]

Die Marschkulturkommission, ihre Entstehung Aufgabe und Tätigkeit, *Dr. Br. Tacke.* (Landw. Jahrb. Band LIV., Erg. 1., 1920.) [63.142.]

Die Wertverluste des Kalksickstoffs beim Lagern, *Dr. F. Weiske.* (Landw. Jahrb. Band LIV., Heft 4, 1920.) [63.1623.]

Early English Forest Regulations, *J. D. Guthrie.* (Jour. of Forestry, Amer., Vol. XVIII., No. 5, 1920.) [34.]

Some Bee Diseases, *J. Tinsley.* (Scot. Jour. of Agric., Vol. III., No. 3.) [63.81.09.]

Scottish Pure Bred Livestock.—IV., Highland Cattle, *J. Cameron.* (Scot. Jour. of Agric., Vol. III., No. 3.) [63.602.]

Flax and its Cultivation, *P. Ryan.* (Jour. of Agric., Vict., May, 1920.) [63.3411.]

Branding and Ear-marking Stock, *H. A. Mullett.* (Jour. of Dept. of Agric., Vict., May, 1920.) [63.6.]

Der Hund in der Geschichte und Saga, *K. Balz.* (Zeit. f. Forst. v. Jagdw., Band LII., Heft 4, 1920.) [63.67.]

Bericht über eine Prüfung des Hoybergschen Verfahrens zur Milchfettbestimmung. (Milchw. Zentralblatt, Jahrgang 49, Heft 8, 1920.) [63.712.]

Studies on the Influence of Humidity upon the Strength and Elasticity of Wool Fiber, *J. I. Hardy.* (Jour. Agric. Res., Vol. XIX., No. 2, April, 1920.) [63.761.]

The Use and Making of Ensilage, *A. J. Perkins.* (Jour. of Agric. of S. Austr., Vol. XXIII., No. 12, July, 1920.) [63.1985.]

Electro-Culture, *F. J. Rae.* (Jour. of Dept. of Agric., Victoria, Vol. XVIII., No. 7, July, 1920.) [537.]

The Antagonistic Action of Calcium and Iron Salts towards other Salts as measured by Ammonification and Nitrification, *J. E. Greaves.* (Soil Science, Vol. X., No. 2.) [63.113.]

Resultats des Experiences dans la Forêt de Lamotte Beuvron. (Rev. des Eaux et Forêts, Tome LVIII., No. 9, Sept., 1920.) [63.196.]

Forskene i havebruket (Spraying for Weeds—its effect on ordinary kitchen garden crops.) (Beretning om Fjerde Skoleaar, 1918. Statens Smaabrukslaererskole.) [63.29; 63.295.]

Lightning Injury to Herbaceous Plants, *Jones and Gilbert.* (Phytopathology, Vol. VIII., No. 6, June, 1918.) [63.21.]

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